JIS COLLEGE OF ENGINEERING
NAAC 'A' Accredited Autonomous Institution
Affiliated to MAKAUT

DEPARTMENT OF ELECTRICAL ENGINEERING
NBA TIER-I ACCREDATED

TECHPULSE

ANNUAL MAGAZINE

A LOOK INTO...

THE FUTURE OF RENEWABLE ENERGY TECHNOLOGY

FOLLOW US ON:

2022-2023

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From the Principal's desk

Prof.(Dr.) Partha Sarkar
Principal, JIS College of Engineering

It is my great pleasure to welcome you all to JIS College of Engineering, NAAC 'A' Accredited Autonomous Institute at West Bengal. JIS College of Engineering was established in the millennium year 2000 by JIS Group. JIS Group is the largest educational conglomerate in the state of West Bengal and leading Private sector Educational Group dedicated to impart demand driven education in Science, Engineering, Technology, Management and Medical Science with highly laudable quality. Over the last decade grown in rapid strides transform it into an Autonomous Institute. The Institution was accredited by National Assessment and Accreditation Council (NAAC) in 2009 and all its eligible technological departments are accredited by National Board of Accreditation (NBA).

The Institution had been declared as an Autonomous Institution by the University Grant Commission in 2011. The Institution is approved by All India Council for Technical Education (AICTE) and affiliated to Maulana Abul Kalam Azad University of Technology, West Bengal. The Institution has been recognised as a Three Stars institution by the QS Intelligence Unit. Hosting and arranging R&D events like National and International Conference/ Workshop / Seminar are organised at regular interval at this institute. In a recently concluded survey of Times News group, the Institution ranked 35th amongst the Private self-financed Institution and 81st among all Engineering Institution in the Country.

From the HOD's desk

Dr. Papun Biswas
HOD, Department of
Electrical Engineering

We transform the youth into finest technocrats to lead the world round, set the way of living from the latest consumer healthcare technologies. Our commitment to the society shall be upholding the world to its highest standard. We take pride in providing every student with high-quality teaching in state-of-the-art facilities and a supportive and friendly environment. We aim to deliver an outstanding student experience that provides a lifetime of fantastic memories, matched by courses which equip you with high-level skills and boost your employ-ability.

THE EDITORIAL

OUR EDITORIAL JOURNEY

Welcome to TechPulse, a yearly magazine of the department of Electrical Engineering at JIS College of Engineering. Every edition is a medium through which the ingenuity and hard work of the students of this esteemed institute are valued. This year's edition- "Renewable Energy Technology" is yet another representation of the same. The students throughout the session have strived for excellence, they have put their best foot forward and made every event a huge success throughout the academic session 2022-23. And so, compiling the student's colossal effort into a few pages wasn't an easy task and wouldn't have been possible without the wonderful core team of TechPulse 2022-23.

It has been a wonderful journey working for the magazine, more so an unparalleled learning experience.

The editorial offers its sincere thanks to Dr. Papun Biswas, HOD, dept. of EE, for entrusting us with this honorous responsibility. We are veritably grateful to Dr. Alok Kumar Srivastav, Mr. Partha Das and Mrs. Gargi Roy, Asst. Professor of dept. of EE, for being a constant source of motivation and support. This year's magazine brings you the concept of Renewable Energy, the energy of future world. Dive into our feature articles exploring the types of Renewable Energy and it's impact and need for a sustainable future. Join us on a journey into the future of green energy, where technology empowers healthier lives like never before.

Cheers!
Team TechPulse

MEET THE TEAM (FACULTY EDITOR)

DR. ALOK KUMAR SRIVASTAV

ASSISTANT PROFESSOR,
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ELECTRICAL ENGINEERING

MRS. GARGI ROY

ASSISTANT PROFESSOR,
DEPARTMENT OF
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PARTHA DAS

ASSISTANT PROFESSOR,
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STUDENT EDITOR

Arkaprio Bhattacharya

B.Tech, EE, 2nd Year

IT IS AN HONOR TO BE A PART OF THE EDITORIAL TEAM AND I HOPE OUR EFFORTS DO JUSTICE TO THE SAME. THIS EDITION WILL SURELY BE A REMINDER OF THE WONDERFUL YEARS WE'VE SPENT AT JISCE. EACH MEMBER OF THE TEAM HAS CONTRIBUTED TO A PIVOTAL ROLE IN MAKING TECHPULSE A SUCCESS. WE HOPE OUR READERS INDULGE IN REMINISCENCE OF THEIR TIME AND TAKE AWAY VALUABLE KNOWLEGE FROM THIS EDITION. THE TEAM MAY CHANGE BUT THE LEGACY CONTINUES.

Sattick Chanda

B.Tech, EE, 2nd Year

Subhajit Saha

B.Tech, EE, 3rd Year

Vision of the Department (DV)

To impart technical knowledge, develop skills for research and innovation and prepare graduates with a great human value to meet the industry and societal needs.

Mission of the Department (DM)

DM 1 - To impart quality engineering education with holistic development and to produce engineers, technologists, scientists and citizens who will contribute meaningfully to the growth and development for future generation of the country.

DM 2 - To promote interdisciplinary research work and opportunity to work in a team through collaborative research and project work to meet the future challenges for society.

DM 3 - To inculcate professional ethics focus on excellence in curricular, co-curricular and extracurricular activities and moral responsibility for a better society

Program Educational Objectives (PEO)

PEO 1. Graduates will have initiate their careers in industry, government and private sector, research organizations or become an entrepreneur

PEO 2. Graduates will pursue higher education in electrical engineering or other fields of their comfort

PEO 3. Graduates will work in a team with leadership quality, show ethical values, express with effective communication, concern to environment and commitment to safety and development of society in the field they choose to pursue

WHAT IS RENEWABLE ENERGY?

Renewable energy is derived from natural sources that are replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat. Unlike fossil fuels, which are finite and emit greenhouse gases when burned, renewable energy sources are sustainable and have a much lower environmental impact. The shift to renewable energy is crucial for mitigating climate change, reducing pollution, and ensuring a sustainable energy future.

Types of Renewable Energy :-

- **Photovoltaic (PV) Systems:** These systems convert sunlight directly into electricity using solar cells made of semiconductor materials. PV panels can be installed on rooftops, ground-mounted, or integrated into building materials.
- **Onshore Wind:** Onshore wind farms are located on land and use wind turbines to convert wind kinetic energy into electricity. They are widely used due to their relatively lower cost and ease of installation.
- **Offshore Wind:** Offshore wind farms are located in bodies of water, where wind speeds are generally higher and more consistent than on land. Offshore wind turbines can generate more electricity but are more expensive to install and maintain.

- **Large-Scale Hydropower:** This involves the construction of large dams on rivers to create reservoirs. Water released from the reservoir flows through turbines to generate electricity. Large-scale hydropower provides significant energy but can have environmental and social impacts.
- **Small-Scale and Micro Hydropower:** These systems are similar to large-scale hydropower but are smaller in scale and typically less disruptive to local ecosystems. They are often used in remote areas to provide local power supply.
- **Biofuels:** Biomass can be converted into liquid fuels like ethanol and biodiesel, which can be used in transportation. Biofuels are produced from crops like corn, sugarcane, and soybeans, as well as from waste materials.
- **Geothermal Power Plants:** These plants use heat from the Earth's interior to generate electricity. Wells are drilled into geothermal reservoirs to bring hot water and steam to the surface, which then drives turbines.
- **Geothermal Heating and Cooling:** Geothermal heat pumps use the relatively constant temperature of the ground to heat and cool buildings. This technology is highly efficient and reduces reliance on fossil fuels.
- **Tidal Energy:** Tidal energy harnesses the power of ocean tides to generate electricity. Tidal barrages, underwater turbines, and tidal stream systems capture the kinetic energy of moving water.
- **Wave Energy:** Wave energy devices capture the energy of ocean waves to generate electricity. Various technologies, such as oscillating water columns and point absorbers, are being developed to harness wave power.

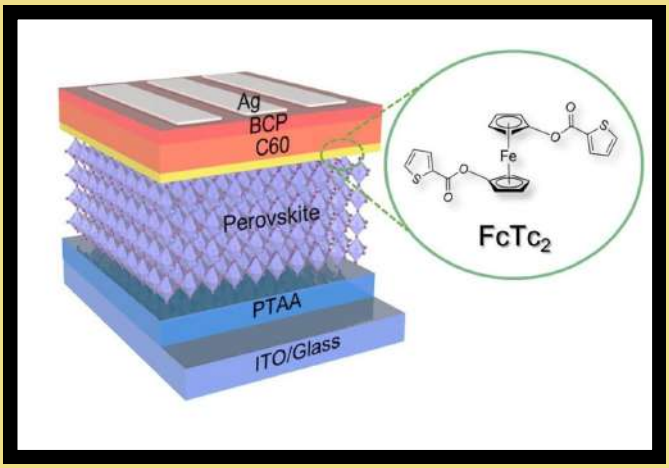
Renewable energy encompasses a diverse array of technologies that harness natural, inexhaustible sources to produce clean and sustainable power. Each type of renewable energy has its unique advantages and challenges, and the optimal mix of these resources will vary based on geographic, economic, and technological factors. The transition to renewable energy is essential for addressing climate change, reducing pollution, and ensuring a sustainable and resilient energy future.

Subhajit Saha

B.Tech, EE, 4th Year

PEROVSKITE SOLAR CELLS: REVOLUTIONIZING SOLAR TECHNOLOGY

Perovskite Solar Cells (PSCs) represent a groundbreaking advancement in solar technology, offering a promising alternative to traditional silicon-based solar cells. Named after the mineral Perovskite, which shares the same crystal structure, these cells have gained significant attention due to their exceptional light-absorbing properties and potential for high efficiency at a lower cost.



Some advantages of these Solar Cells are-

i) High Efficiency: *Perovskite Solar Cells have shown remarkable improvements in efficiency, with laboratory-scale devices achieving over 25% efficiency. This rapid progress rivals that of established silicon solar cells, which took decades to reach similar efficiency levels.*

ii) Low Production Costs: *The materials and manufacturing processes for PSCs are less expensive compared to silicon solar cells. Perovskite materials can be processed using solution-based techniques, which are simpler and more cost-effective than the high temperature processes required for silicon.*

iii) Versatility: *Perovskite Solar Cells can be manufactured on flexible substrates, allowing for a wide range of applications beyond traditional solar panels. This includes integration into building materials, portable electronics and even clothing.*

iv) Lightweight and thin: *The thin-film nature of PSCs makes them lightweight and easy to transport and install. This is particularly advantageous for applications where weight and flexibility are critical factors.*

Subhangi Das

B.Tech, EE, 4th Year

EVOLUTION OF HYDROPOWER: FROM ANCIENT WHEELS TO MODERN INNOVATIONS

Hydropower is one of the oldest sources of renewable energy, dating back thousands of years. It has evolved significantly, transforming from simple water wheels into sophisticated systems that harness the power of water to generate electricity on a massive scale.

Ancient Times:

The earliest use of hydropower can be traced back to ancient Greece and China, where water wheels were used for grinding grain and pumping water. These early machines utilized the kinetic energy of flowing water to perform mechanical work.

Industrial Revolution:

The Industrial Revolution saw significant advancements in hydropower technology. Water wheels became more efficient and were used to power machinery in factories and mills. The development of the hydraulic turbine in the 19th century marked a pivotal moment, enabling more effective conversion of water energy into mechanical power.

iii) Large-Scale Dams:

The 20th century witnessed the construction of large-scale dams and hydroelectric power station.

Iconic projects like the Hoover Dam in the USA and the Three Gorges Dam in China exemplify the massive scale of hydroelectric power generation. These projects not only provide electricity but also offer flood control, irrigation and water supply benefits.

iv) Small & Micro Hydropower:

Advances in technology have enabled the development of small and micro hydropower systems, which can be deployed in remote areas and smaller rivers. These systems are less invasive and more adaptable to various geographical conditions, providing localized energy solutions.

The evolution of hydropower reflects a journey of continuous innovation and adaptation. From ancient water wheels to modern pumped storage and floating systems, hydropower has played a crucial role in energy generation for centuries. As technology advances and environmental considerations become more prominent, hydropower will continue to evolve, contributing to a sustainable and resilient energy future.

Tuhinangshu Banik

B.Tech, EE, 1st Year

FUTURE OF HYDROPOWER

The future prospects of Hydropower are very much promising towards the mankind. They are-

i) Digitalization and Smart Grids: *The integration of digital technologies and smart grid systems is revolutionizing hydropower. Advanced monitoring and control systems improve efficiency, reduce maintenance costs, and optimize water usage. These innovations enable more precise management of water resources and energy production.*

ii) Environmental and Social Sustainability: *Future hydropower development emphasizes sustainability and minimizing environmental impact. Innovative approaches, such as low-head hydropower and nature-like fish passages, aim to balance energy generation with ecological preservation.*

iii) Global Expansion: *Developing countries with abundant water resources are increasingly investing in hydropower to meet growing energy demands. International collaboration and investment are driving the expansion of hydropower infrastructure, contributing to global renewable energy goals.*

Arkaprio Bhattacharya

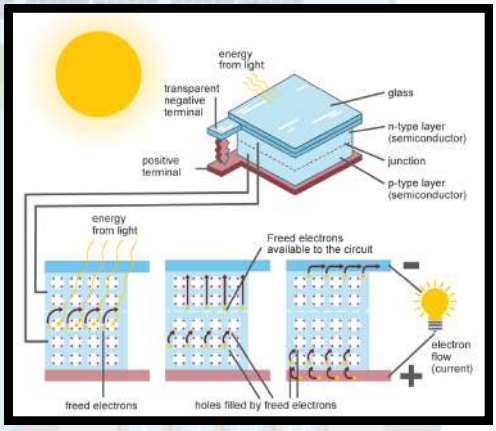
B.Tech, EE, 2nd Year

IS RENEWABLE ENERGY TECHNOLOGY COST-EFFECTIVE OR NOT ?

Renewable energy technologies have seen dramatic cost reductions over the past few decades, driven by technological advancements, economies of scale, and supportive policies.

- **Solar Photovoltaic Systems:**

The cost of solar PV has decreased by over 80% since 2010. Advances in manufacturing, increased production capacity, and improved efficiency have significantly driven down costs. The global weighted-average levelized cost of electricity for utility-scale solar PV projects fell from around $0.38/kWh in 2010 to $0.06/kWh in 2020.



- **Onshore Wind Energy Systems:**

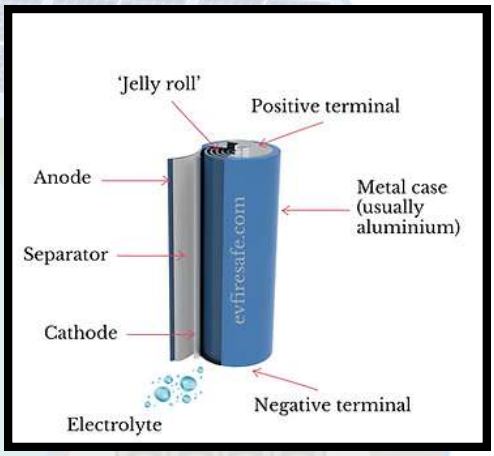
Onshore wind energy costs have decreased by approximately 40% over the past decade. The global average LCOE for onshore wind projects fell from around $0.09/kWh in 2010 to $0.05/kWh in 2020. This reduction is attributed to larger, more efficient turbines, improved logistics, and better site management.

- **Large-Scale Hydropower:**

The costs for large-scale hydropower projects have remained relatively stable, as these projects are highly site-specific and dependent on geographical and environmental conditions. The LCOE for large hydropower projects typically ranges between $0.03 and $0.06/kWh.

- **Lithium-Ion Batteries:**

The cost of lithium-ion batteries, critical for energy storage and grid stability, has dropped by about 85% since 2010. Prices fell from over $1000/kWh to around $137/kWh in 2020, with further reductions expected as technology advances and production scales up.



The cost trends of renewable energy technologies highlight a positive trajectory towards more affordable and accessible clean energy. Significant cost reductions across solar, wind, hydropower and battery storage have made renewable energy increasingly competitive with traditional fossil fuels. As these trends continue, renewable energy is poised to play a central role in the global transition to a sustainable energy future.

Ankur Roy

B.TEch, EE, 1st Year

POTENTIAL OF HYDROGEN AS A CLEAN FUEL

Hydrogen is increasingly recognized as a versatile and clean fuel that can play a a significant role in the transition to a sustainable energy future. Its potential lies in its ability to decarbonize various sectors, including industry, transportation and power generation.

Hydrogen fuel cells can power vehicles, from cars and buses to trucks and trains. Fuel cell electric vehicles (FCEVs) emit only water vapor, making them a clean alternative to internal combustion engine vehicles. Hydrogen is particularly suited for heavy-duty transportation, where batteries may be less practical due to weight and range limitations.

Hydrogen can replace fossil fuels in high-temperature industrial processes such as steelmaking, chemical production and refining. Its use can significantly reduce carbon emissions in these hard-to-abate sectors.

Hydrogen holds immense potential as a clean fuel that can significantly contribute to global decarbonization efforts. While there are challenges to overcome, such as production costs and infrastructure development, the ongoing advancements in technology and supportive policies are paving the way for hydrogen to become a cornerstone of the sustainable energy landscape. By leveraging hydrogen's versatility and zero-emission characteristics, we can create a more resilient, clean and integrated energy systems for the future.

Sumana Koley

B.Tech, EE, 3rd Year

BENEFITS OF ELECTRIC VEHICLES

Electric Vehicles (EVs) are set to play a pivotal role in the future of transportation and the global push toward sustainability. As technology advances, the adoption of EVs is accelerating, driven by environmental concerns, technological innovations and supportive policies.

- **Lower Running Costs:**

The running cost of an electric vehicle is much lower than an equivalent petrol or diesel vehicle. Electric vehicles use electricity to charge their batteries instead of using fossil fuels like petrol or diesel. Electric vehicles are more efficient and that combined with the electricity cost means that charging an electric vehicle is cheaper than filling petrol or diesel for our travel requirements.

- **Low maintenance cost:**

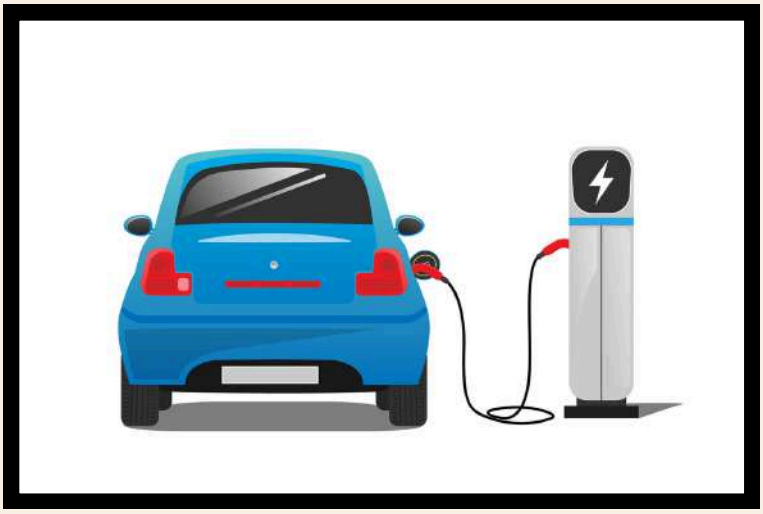
Electric vehicles have very low maintenance costs because they don't have as many moving parts as an internal combustion vehicle. The servicing requirements for electric vehicles are lesser than the conventional petrol or diesel vehicles.

- **Zero Tailpipe Emissions:**

Driving an electric vehicle can help you reduce your carbon footprint because there will be zero tailpipe emissions. You can reduce the environmental impact of charging your vehicle further by choosing renewable energy options for home electricity.

- **Electric Vehicles are easy to drive and quiet:**

Electric vehicles don't have gears and are very convenient to drive. There are no complicated controls, just accelerate, brake, and steer. When you want to charge your vehicle, just plug it in to a home or public charger. Electric vehicles are also quiet, so they reduce noise pollution that traditional vehicles contribute to.



- **No noise pollution:**

Electric vehicles have the silent functioning capability as there is no engine under the hood. No engine means no noise. The electric motor functions so silently that you need to peek into your instrument panel to check if it is ON. Electric vehicles are so silent that manufacturers have to add false sounds in order to make them safe for pedestrians.

Antara Kundu

B.Tech, EE, 3rd Year

DELVE INTO THE FUTURISTIC WORLD OF...

RENEWABLE ENERGY RESOURCES

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