SKILL DEVELOPMENT INSTITUTE BHUBANESWAR

Managed by Indian Oil

SDI-B

Pulse

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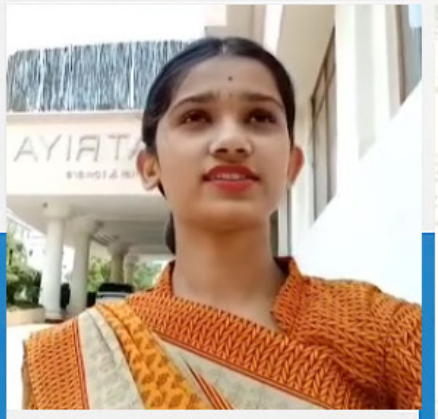

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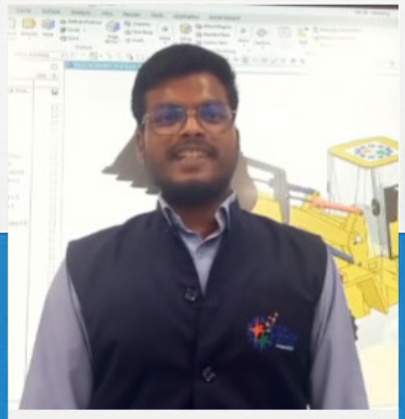

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Events and Happenings of SDI-B

6th – 10th Jan'25: NIRMAN 2nd Phase Training Program for IOCL Executives

L&D Marketing Head Office, IOCL conducted NIRMAN 2nd Phase, a Leadership Development Program for IOCL officers in Grade E & F in which twenty (20) E and F grade officers of the marketing division across the country participated. Shri M R Das, ED (HR), HO, Shri Ranjan Bhowmick, CEO, SDI-B and Shri Nihar Ranjan Das, DGM(Training), SDI-B interacted with officers in the meeting. During the program, CEO, SDI-B briefed about objectives and various activities of SDI-B. The five-day program concluded with Paradip refinery visit by the participating officers.

9th Jan'25: Campus visits for students from Kendriya Vidyalayas (KV-2) focused on exposure to new technologies

The campus visits successfully met its goal of providing Kendriya Vidyalaya (KV-2) students with exposure to both foundational skills and cutting-edge technologies. From hands-on training in welding, fitting, and fabrication to advanced demonstrations of CNC machines, Robotics, IoT, and Cybersecurity, students gained a comprehensive understanding of how traditional and modern technologies coexist and evolve in industries worldwide. The visit not only sparked curiosity but also encouraged students to think critically about technology's role in shaping the future. It is clear that such exposure plays a crucial role in motivating students to pursue careers related to STEM and explore new avenues in technology. A total of 203 Nos. of students along with 13 Nos. teachers visited the campus.

9th Jan'25: Visit of Director (Marketing), IOCL

Shri V Satish Kumar, Director (Marketing), IOCL visited SDI-B campus and was accorded a warm welcome by Shri Ranjan Bhowmick, CEO, SDI-B. During the visit, he was briefed about the various operational aspects of SDI-B; including courses offered, placements and various teaching methods. In his address, Shri V Satish Kumar underlined the importance of adding new courses in line with emerging demands duly validated by industry. He also encouraged using social media to enhance the institute's visibility, promote its activities, and attract students from various states of India.

10th Jan'25: Mentor – Mentee Program

Mentor-mentee program aims to assist mentees to enhance their talents and grow professionally and personally that focuses on areas such as acculturation, priority setting, networking, career planning and counselling related to the individual's (mentee's) identified goals toward advancement in their field, challenges (if any). A group of ten candidates from various trades have been formed and submitted to different officers to assess the program. The CEO of SDI-B led the mentor-mentee program with a participation of 9 candidates from several trades.

18th – 19th Jan'25: SERPL, IOCL Cricket Championship Tournament -2025

The annual tennis ball cricket tournament organized by the Southeastern Region Pipeline (SERPL) division of IOCL at the Sports Complex of SDI-B was truly a remarkable event, with this; the Sports complex of SDI-B being fully utilized to its fullest capacity. More than just a sporting competition, it served as an excellent platform for celebrating teamwork, collaboration, and employee interaction across the various IOCL locations within the SERPL division. CGM, SERPL inaugurated the event by flagging off a march of teams from different locations. This act not only set the tone for the tournament but also fostered a sense of unity and enthusiasm among the employees as well as such programs that helped SDI-B towards its sustainability goal. The participation of teams from diverse locations enhanced the collaborative spirit, allowing employees to connect with colleagues beyond their usual professional circles, thus boosting morale and strengthening bonds within the organization. During the closing ceremony, ED, SERPL, IOCL addressed the gathering, highlighting the significance of the facilities developed by Oil PSUs and emphasizing the critical role of sports in promoting work-life balance. The ED's remarks underscored the value of sports events in encouraging physical well-being and maintaining mental focus, ultimately contributing to a healthier, more engaged workforce.

26th Jan'25: Republic Day Celebration

The 76th Republic Day celebration at SDI-B began with the unfurling of the National Flag by Shri. Ranjan Bhowmick, CEO, SDI-B, accompanied by the National Anthem. This ceremonial moment included a guard of honor, symbolizing respect for national symbols and the unity of the country. After the flag unfurling, the CEO addressed the gathering, emphasizing the significance of Republic Day and reflecting on India's journey since 1950. He honored the brave soldiers who fought in various wars, highlighted the country's economic progress, and stressed the importance of awareness about constitutional rights and social justice. He also reminded everyone of their duties as citizens to contribute to the nation's growth. To foster a sense of pride, the CEO felicitated contributors and concluded the event by distributing sweet packets, sharing joy and celebration with all present.

29th Jan'25: Visit of Mr. Chanchal Rana, IAS, Collector and DM, Khordha

Shri. Chanchal Rana, the Collector and District Magistrate of Khordha, visited the SDI-B campus. He was warmly welcomed by Shri. Rajesh Kumar Tripathy, Chief Operating Officer (COO). During the meeting, Shri. Rana was given an overview of the various skill development courses offered at the campus, the related employment generation, and the growth journey of SDI Bhubaneswar. He was also briefed on the key facilities available at the campus. In the course of the discussion, Shri. Rana emphasized the importance of offering more futuristic courses, particularly in emerging fields such as renewable energy and semiconductor manufacturing, where there is significant demand in the industry.

29th Jan'25: Participation of SDI-B at Utkarsh Odisha – Make in Odisha Conclave

The Prime Minister, Shri Narendra Modi inaugurated the Utkarsh Odisha – Make in Odisha Conclave 2025 and Make in Odisha Exhibition in Bhubaneswar, Odisha. Noting that this was the biggest business Summit in Odisha till date, Shri Modi said that there were around 5-6 times more investors participating in Make in Odisha Conclave 2025. This landmark event serves as a dynamic platform to highlight Odisha's industrial strengths, unparalleled strategic advantages, and vast growth opportunities for investors from across the globe. CEO, SDI-B attended the conclave and students of SDI-B also give their presence in the conclave as well.

3rd Feb'25 - 7th Feb'25: HANSA 2.0 for IOCL Executives

L&D Western Regional Office, IOCL conducted HANSA, a new Leadership Development Program for IOCL officers in which 27 officers of the marketing division across the country participated. Shri Ranjan Bhowmick, CEO, SDI-B, and Nihar Ranjan Das, DGM(Training), SDI-B interacted with officers in the meeting. During the program, CEO, SDI-B briefed about objectives and various activities of SDI-B. The five-day program concluded with Paradip refinery visit by the participating officers.

8th Feb'25: 2nd Annual Sports Meet of SDI-B

Every year, the Annual Sports Meet is held at SDI, Bhubaneswar to encourage active participation among students and faculty in various sporting events. The 2nd Annual Sports Meet took place. The event was inaugurated by the CEO of SDI, Bhubaneswar, Shri. Ranjan Bhowmick, who delivered an inspiring address to the students, emphasizing the importance of sports for overall well-being and personal development. A wide range of sports events were organized, including cricket, volleyball, indoor games such as table tennis, as well as sprint competitions for both male and female participants in the 100m and 200m races. Students participated with great enthusiasm and motivation. At the conclusion of the event, winners from all competitions were felicitated with trophies to acknowledge their achievements.

13th Feb'25 - 15th Feb'25: MADHYAMA-1 for IOCL Executives

L&D, Southern Regional Office, IOCL conducted MADHYAMA-1 Outbound Experiential Learning (OBEL) Program for IOCL executives in which 21 officers of marketing division of southern region participated. Shri Nihar Ranjan Das, DGM (Training), SDI-B interacted with officers in the meeting and briefed about objectives and various activities of SDI-B. The program concluded with one day Konark visit by the participating officers.

20th Feb'25 - 22nd Feb'25: MADHYAMA-2 for IOCL Executives

L&D, Southern Regional Office, IOCL conducted MADHYAMA-2 Outbound Experiential Learning (OBEL) Program for IOCL executives from 20th February to 22nd February in which 15 officers of marketing division of southern region participated. Shri Ranjan Bhowmick, CEO, SDI-B interacted with officers in the meeting and briefed about objectives and various activities of SDI-B. The program concluded with one day Konark visit by the participating officers.

25th Feb'25: Visit of Schneider top management executives to SDI-B

Top management executives from Schneider Electric France visited SDI-B. Schneider dignitaries comprised of Ms. Chris Leong, Chief Sustainability Officer, Mr. Gilles Vermot Desroches, Senior Vice President Corporate Citizenship and Institutional Affairs, Mr. Francois Milioni, Learning and Entrepreneurship Global leader, Ms. Axelle Ponthieux, Chief of Staff Corporate Citizenship, Mr. Ravi Bhushan Singh, Director Business in education and Mr. Sai Krishna Rao, Sr. General Manager Education. During the meeting, CEO,SDI-B briefed the dignitaries about various operational activities of SDI-B. Team Schneider suggested various means to improve collaboration between Schneider Electric and SDI-B.

27th Feb'25: FDP on " The Role of CAD Design in Contemporary Industries "

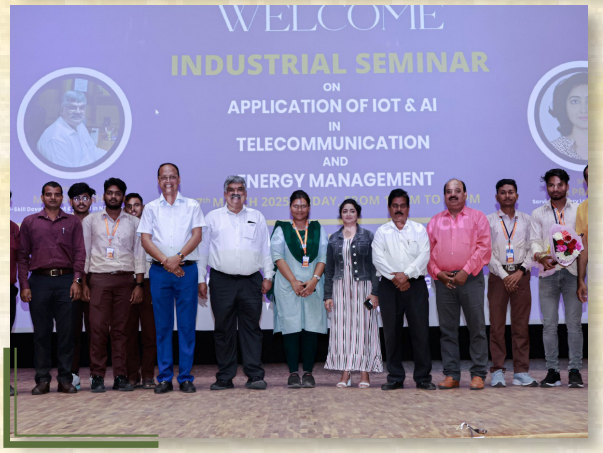
A three days Faculty Development Program (FDP) was condudted on topic "The Role of CAD Design in Contemporary Industries".The main goal of this Programme is to acquire practical expertise in Computer-Aided Design (CAD) within industrial contexts. This involves the creation of accurate 2D and 3D digital representations of products, which allows designers and engineers to effectively visualize, develop, modify, and enhance designs prior to physical production.

1st Mar'25 - 7th Feb'25: Visit of Japan International Cooperation Agency (JICA)

Members of the JICA (Japan International Cooperation Agency) headquarters and its India counterparts recently visited SDI Bhubaneswar to discuss prospective options for exporting skilled resources from SDI to Japan. The visit aimed to improve collaboration and explore how SDI's highly skilled personnel may contribute to Japan's growing demand for expertise in a variety of industries. During the discussion, CEO, SDI-B, briefed about objectives and various activities of SDI-B.

7th Mar'25: Seminar on Application of IoT and AI Telecommunication and Energy Management

SDI-B Training Partner, NTTF organized an Industrial Seminar on Application of IoT and AI Telecommunication and Energy Management at SDI-B Auditorium. Shri N Suresh, Head Skill Development & Digital, NTTF, Ms Prakruthi, Lead, Delivery Excellence, Ericsson, Bengaluru, guest the Seminar as Guest of Honor and esteemed Speaker. The Speakers shared their 20+ years of vast experience and expertise in the field of IoT and AI Telecommunication and Energy Management. The Seminar was a grand success with participation of approx. 400 candidates.



10th Mar'25 - 11th Mar'25: Samanvaya for IOCL Executives

HSE Marketing Head Office, IOCL conducted Samanvaya-Inter Divisional Health and Environment Meet for IOCL HSE officers in which 29 officers across divisions of IOCL participated. ED (HS&E) Refinery HQ, ED (HS&E) Pipeline HO, ED (HS&E) Marketing HO, ED I/C (Security & HS&E) Corporate Office and CGM & SH Odisha State Office graced the meeting. During the program, CEO SDI-B briefed about objectives and various activities of SDI-B. In the meeting, the different safety aspects of all three divisions of IOCL were also discussed.

Cyber Security for Everyone

In our previous issue, we explored foundational cyber security habits everyone should adopt. As we enter a new year filled with evolving digital landscapes and sophisticated threats, it's time to go a step further. Here's how you can level up your cyber safety in 2025.

1. Understand the Threat Landscape

Cyber attacks are no longer limited to phishing or malware. Ransomware, deepfakes, and AI-driven scams are becoming more prevalent. Awareness is your first line of defense.

2. Strengthen Your Digital Hygiene

- Use **password managers** to create and store complex passwords.
- Regularly **review app permissions** and revoke unnecessary access.
- Log out of accounts when not in use, especially on shared or public devices.

3. Keep Your Devices Battle-Ready

- Enable **auto-updates** on operating systems and apps.
- Install **trusted antivirus software.**
- Regularly **backup data** to cloud or external drives.

4. Zero Trust Mindset

Adopt a "trust nothing, verify everything" approach:

- Double-check suspicious emails, even if they appear to come from familiar contacts.
- Never share personal or company data on unsecured platforms.

5. Be Cautious with AI Tools

AI chatbots and productivity tools are booming—but so are AI-based scams. Avoid sharing sensitive data and check the credibility of generated content before acting on it.

6. Train Your Team and Family

Security awareness is not just for IT departments. Regular training can help your team and loved ones avoid common pitfalls.

7. Watch Out for Social Engineering

Scams are getting personal. Be skeptical of urgent messages asking for money, gift cards, or login credentials.

8. Monitor Your Digital Footprint

Use online tools to monitor where your information appears. Set alerts for data breaches and consider freezing your credit if exposed.

Cyber security is a journey, not a destination. Whether you're a student, employee, entrepreneur, or parent, staying vigilant and informed is key. The best defence is a proactive one.

Let's test your understanding with some questions!

Cyber Security – Quiz Questions

1.What is one of the biggest cyber threats emerging in 2025?

A	Pop-up ads	B	Deepfakes and AI-driven scams	C	Slow internet connections	D	Broken keyboards

2.What does a password manager help you do?

	Block spam emails	B	Store and generate strong passwords	C	Speed up internet browsing	D	Share passwords with friends

3.What is the "Zero Trust" approach in cyber security?

A	Trusting only company emails	B	Avoiding all software updates	C	Trust nothing, verify everything	D	Sharing access with coworkers

4.Why is it important to review app permissions regularly?

A	To get more notifications	B	To avoid app crashes	C	To reduce battery usage	D	To limit access to your personal data

5.What should you do if an email from a known contact seems suspicious?

A	Click the link to confirm	B	Forward it to others	C	Reply with personal details	D	Verify before taking any action

6.What is one recommended way to protect your data in case of device failure or attack?

A	Delete all files regularly	B	Only use Wi-Fi	C	Back up data to the cloud or external drive	D	Share files via email

7.Why should you be cautious while using AI tools?

A	They can make grammar mistakes	B	They might leak or misuse your data	C	They are slow	D	They charge per word

8.Which of these is NOT a good cyber hygiene habit?

A	Logging out from accounts after use	B	Ignoring software updates	C	Using antivirus protection	D	Setting strong, unique passwords

9.What is a sign of a social engineering attack?

A	A system update notification	B	A game app request	C	A message urgently asking for money or credentials	D	A calendar invite

10.How can you monitor your digital footprint?

A	By deleting your browser history	B	By using online tools and breach alerts	C	By changing your wallpaper	D	By using public Wi-Fi

India's Renewable Energy Landscape: Powering a Sustainable Future

India stands at the forefront of the global energy transition, embarking on an ambitious journey to build a sustainable and secure energy future. With its vast renewable energy potential and unwavering commitment to climate action, the nation is rapidly transforming its energy landscape. From sprawling solar parks in the deserts of Rajasthan to towering wind turbines along the coastal plains, India is harnessing its natural resources to power its burgeoning economy and meet its growing energy demands. The Indian Renewable Energy market is projected to grow from around USD 21.1 Billion in 2022 to roughly USD 46.7 Billion by 2032, exhibiting a CAGR of approximately 8.77% during this period as per India Renewables Energy Market Research Report.

This quarter, we delve into the dynamic realm of India's renewable energy sector, exploring the remarkable progress achieved, the cutting-edge technologies being deployed, and the policy frameworks driving this transformation. Driven by the imperative to mitigate climate change and ensure energy security, India has set ambitious targets, aiming to achieve 500 GW of non-fossil fuel capacity by 2030. According to a report by IRENA (International Renewable Energy Agency), India's total renewable energy capacity reached approximately 179 GW by the end of 2023. This significant growth underscores the nation's commitment to expanding its renewable energy footprint.

Types of Renewable Energy Powering India's Growth

India's renewable energy landscape is a tapestry woven from diverse sources, each playing a vital role in the nation's energy transition.

1.Solar Power:

Solar power has emerged as a dominant force, contributing significantly to India's renewable energy mix. According to the Ministry of New and Renewable Energy (MNRE), as of February 2024, solar energy accounted for approximately 51% of the total renewable energy capacity, encompassing both utility-scale and rooftop installations. This growth is fuelled by large-scale solar parks, the increasing adoption of rooftop solar, and advancements in solar PV technology. The government's Production Linked Incentive (PLI) schemes are also aimed at bolstering the domestic solar manufacturing sector.

2.Wind Power:

Wind energy remains a substantial contributor, representing about 35% of the total renewable energy capacity as of February 2024. India's established onshore wind sector, particularly in states like Tamil Nadu and Gujarat, is now being complemented by the exploration of offshore wind potential and the repowering of older wind farms. Wind-solar hybrid projects are also gaining prominence, providing a more stable and dispatchable renewable energy source.

3.Hydropower:

Hydropower, a traditional source of renewable energy, continues to play a vital role, contributing about 12% of the total renewable energy capacity as of February 2024. Its importance extends beyond electricity generation, providing crucial grid balancing services. Pumped hydro storage is being explored as a major energy storage solution, and smaller hydro projects are being developed in mountainous regions.

4.Bioenergy:

Bioenergy, while contributing a smaller portion of the mix at roughly 2% as of February 2024, offers decentralized energy solutions and addresses waste management challenges. Biomass power plants utilize agricultural residues and forestry waste, while biogas production is promoted in rural areas, and waste-to-energy projects convert municipal solid waste into electricity.

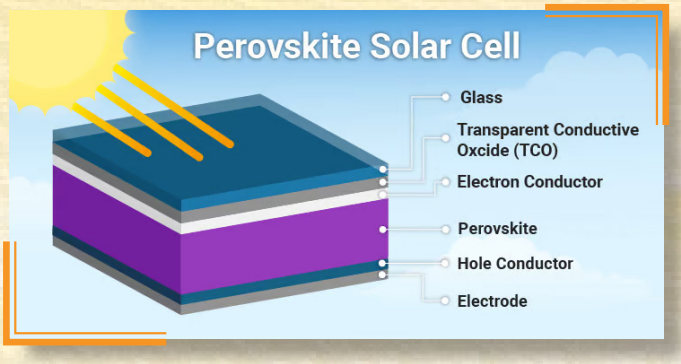
Key Technologies & Innovations Driving the Sector

A. Solar Power Advancements:

India's solar power sector is experiencing a period of rapid technological evolution, driven by the need to enhance efficiency, reduce costs, and integrate solar energy seamlessly into the grid. These advancements are crucial for achieving India's ambitious renewable energy targets.

1. High-Efficiency Photovoltaic (PV) Modules:

- **Bifacial Modules:** These modules capture sunlight from both the front and rear sides, increasing energy yield significantly, especially in environments with high reflectivity. They are becoming increasingly popular in large-scale solar parks.
- **PERC (Passivated Emitter and Rear Contact) Technology:** PERC cells improve the efficiency of traditional silicon solar cells by adding a dielectric passivation layer on the rear surface, reducing electron recombination and enhancing light capture.
- **TOPCon (Tunnel Oxide Passivated Contact) Technology:** TOPCon is a next generation technology that is achieving higher efficiencies than PERC. This is accomplished by a thin tunnel oxide layer.



- **HJT (Heterojunction Technology) Cells:** HJT cells combine crystalline and amorphous silicon, resulting in higher efficiency and better temperature coefficients.
- **Perovskite Solar Cells:** These cells, characterized by their unique crystal structure, are showing rapid increases in efficiency, potentially surpassing traditional silicon cells. They offer the potential for lower manufacturing costs and flexibility due to their thin-film nature. While challenges related to stability, lead content, and scalability remain, perovskite technology holds significant promise for the future of solar energy.

2. Floating Solar Photovoltaic (FSPV) Systems:

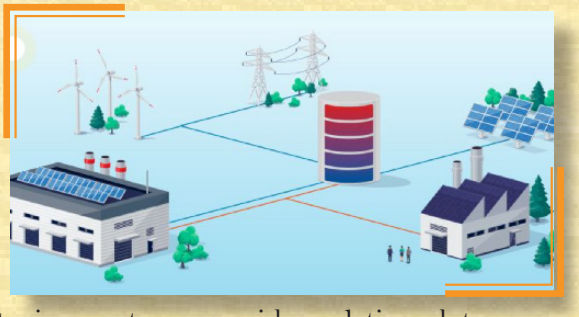
- FSPV systems are installed on water bodies, such as reservoirs, lakes, and ponds. They offer several advantages, including reduced land use, enhanced module cooling, and reduced water evaporation. India is witnessing the development of several large-scale floating solar projects.

3. Advancements in Solar Inverters and Grid Integration:

- **Smart Inverters:** These inverters offer advanced grid support functions, such as voltage and frequency regulation, which are crucial for integrating large amounts of solar power into the grid.

- **Microgrids and Distributed Generation:** The growth of microgrids and distributed solar generation is enhancing grid resilience and providing localized power solutions.

- **Energy Storage Integration:** Integrating battery energy storage systems with solar PV plants is becoming increasingly important for addressing the intermittency of solar power.



4. Digitalization and Smart Technologies:

- **Remote Monitoring and Control:** IoT-enabled monitoring systems provide real-time data on solar plant performance, enabling proactive maintenance and optimization.

- **AI and Machine Learning:** AI/ML algorithms are being used to analyze solar plant data, predict performance, and optimize operations.

- **Blockchain Technology:** Blockchain is being explored for applications such as renewable energy certificate (REC) trading and peer-to-peer energy transactions.

These technological advancements are not only driving the growth of India's solar power sector but also contributing to the nation's broader energy transition goals.

B. Wind Power Evolution

India's wind power sector, while already mature, is undergoing significant evolution driven by technological advancements and a focus on maximizing its potential. Here's a look at the key innovations shaping the sector:

1. Larger and More Efficient Wind Turbines:

- **Increased Rotor Diameter and Hub Height:** Modern wind turbines feature larger rotor diameters and higher hub heights, enabling them to capture more wind energy, especially in lower wind speed regions. This increases the capacity factor of wind farms.

- **Advanced Blade Design:** Aerodynamic improvements in blade design, including optimized aerofoils and advanced materials, enhance energy capture and reduce noise.

- **Direct-Drive Turbines:** These turbines eliminate the gearbox, reducing maintenance requirements and improving reliability.

2. Offshore Wind Energy Development:

India possesses a significant offshore wind potential along its long coastline. Floating Wind turbines are being developed for deployment in deeper waters, expanding the potential for offshore wind development. Building the necessary infrastructure, including offshore substations and transmission lines, is crucial for harnessing offshore wind energy.

3. Repowering of Older Wind Farms:

Repowering involves replacing older, less efficient turbines with newer, more powerful models at existing wind farm sites. Repowering can significantly increase the energy output of wind farms without requiring additional land. It can extend the operational lifespan of wind farms, maximizing their economic benefits.

4. Hybrid Wind-Solar Power Projects:

- **Enhanced Grid Stability:** Combining wind and solar power in hybrid projects provides a more stable and reliable power supply, addressing the intermittency of individual renewable energy sources.

- **Optimized Land Use:** Hybrid projects can optimize land use by co-locating wind and solar installations. Hybrid projects can improve capacity utilization by leveraging the complementary nature of wind and solar resources.

5. Digitalization and Data Analytics:

- **Remote Monitoring and Diagnostics:** IoT-enabled monitoring systems provide real-time data on wind turbine performance, enabling proactive maintenance and optimization.

- **Predictive Maintenance:** AI/ML algorithms are being used to analyze wind turbine data, predict failures, and optimize maintenance schedules.

- **Data-Driven Optimization:** Data analytics is being used to optimize wind farm operations, improve energy production, and reduce costs.

These innovations are driving the wind power evolution in India, making it a more efficient, reliable, and cost-effective source of clean energy.

C. Energy Storage Solutions

Energy storage is becoming increasingly critical for India's renewable energy transition. As the share of variable renewable energy sources like solar and wind grows, energy storage solutions are essential for ensuring grid stability, reliability, and flexibility. Here's a look at the key technologies and innovations driving this sector:

1. Battery Energy Storage Systems (BESS):

- **Lithium-ion Batteries:**

o These are currently the most widely used battery technology for grid-scale and distributed energy storage.

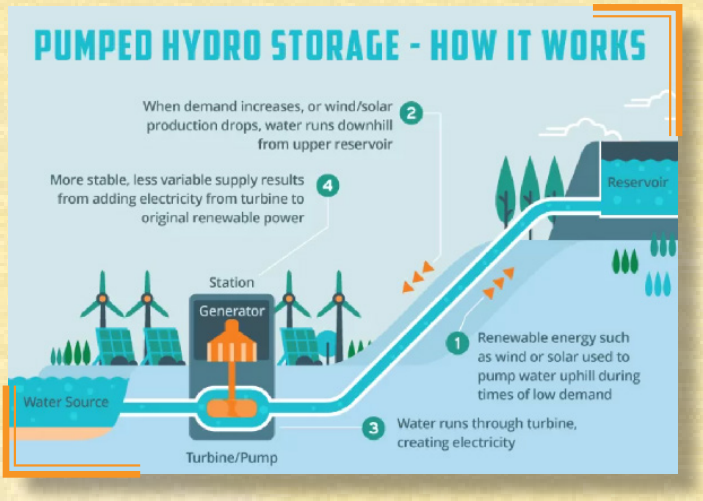
o Advancements in lithium-ion battery technology are focusing on increasing energy density, reducing costs, and improving safety.

- **Advanced Battery Chemistries:**

o Research and development are ongoing in advanced battery chemistries, such as sodium-ion, flow batteries, and solid-state batteries, which offer potential advantages in terms of cost, safety, and environmental impact.

o Flow batteries are gaining traction for grid-scale applications due to their scalability, long cycle life, and safety characteristics.

2. Pumped Hydro Storage (PHS):



PHS is a mature and proven technology for large-scale energy storage. PHS plants store energy by pumping water uphill to a reservoir during periods of excess generation and releasing it to generate electricity during periods of high demand. It can provide long-duration energy storage, which is crucial for balancing seasonal variations in renewable energy generation.

3. Thermal Energy Storage (TES):

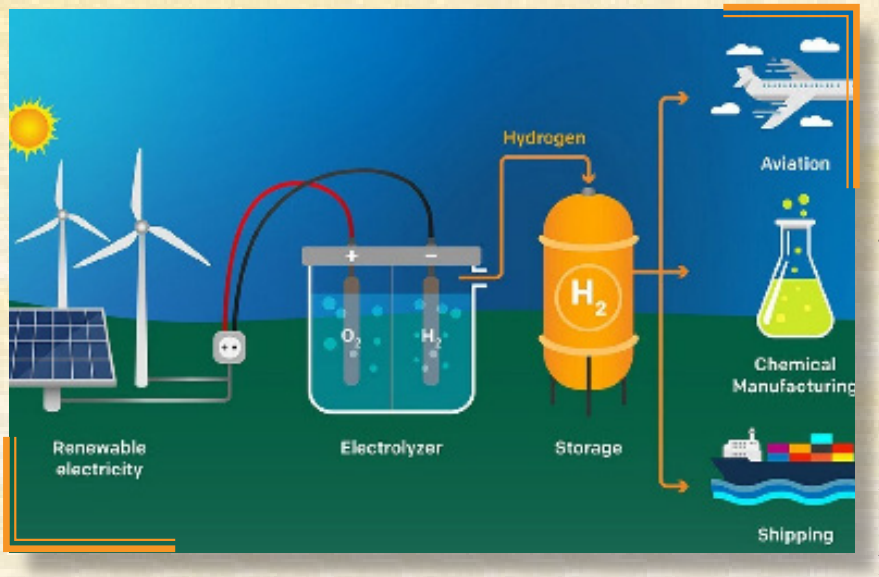
- **Concentrated Solar Power (CSP):** TES is used in CSP plants to store heat from concentrated sunlight, enabling electricity generation during periods of low solar irradiance. TES can also be used in industrial applications to store heat for process heating and other purposes.

Reducing the cost of energy storage technologies is crucial for their widespread adoption. Ensuring the seamless integration of energy storage systems into the grid is essential for grid stability and reliability.

D. Green Hydrogen

India's National Green Hydrogen Mission is a pivotal step towards establishing the nation as a global leader in clean energy. Green hydrogen, produced through the electrolysis of water powered by renewable energy, presents a versatile solution for decarbonizing various sectors.

Production and Applications:



- **Electrolysis Process:** The core of green hydrogen production lies in electrolysis, where an electrolyzer splits water molecules into hydrogen and oxygen using electricity from renewable sources like solar or wind. This ensures a near-zero carbon footprint.

- **Industrial Decarbonization:** Industries such as steel (e.g., companies like JSW Steel exploring green steel production), cement (e.g., companies investigating hydrogen-fuelled kilns), and fertilizer manufacturing (e.g., initiatives to replace natural gas with green hydrogen) are actively exploring green hydrogen as a clean feedstock or fuel source. This significantly reduces their carbon emissions.

- **Transportation:** Green hydrogen can power fuel cell electric vehicles (FCEVs), offering a zero-emission alternative to conventional vehicles. It also has potential applications in heavy-duty transportation, aviation, and shipping, contributing to the decarbonization of these sectors.

- **Power Generation:** Green hydrogen can be used in fuel cells to generate electricity, providing a clean and reliable power source for stationary applications and backup power systems. It can also be blended with natural gas for use in existing gas turbines, gradually reducing the carbon intensity of power generation.

Storage:

Green hydrogen can be stored in various forms to address the intermittency of renewable energy sources and ensure a continuous supply. Common methods include compressed gas storage in high-pressure tanks, liquefied hydrogen for higher energy density and long-distance transport, and underground storage in geological formations like salt caverns or depleted natural gas reservoirs for large-scale, long-term solutions. Additionally, researchers are exploring material-based storage using solid-state materials that can absorb and release hydrogen, offering a safe and compact alternative.

Infrastructure Development:

Building a robust infrastructure for hydrogen production, storage, and transportation is crucial for realizing its potential. This includes:

o **Electrolyzer Manufacturing:** Several Indian companies are entering the electrolyzer manufacturing space, aiming to scale up production.

o **Hydrogen Pipelines:** Companies like IndianOil Corporation Ltd. (IOCL) are actively exploring the potential of utilizing their existing pipeline infrastructure for hydrogen blending and transport.

o **Refuelling Stations:** IOCL, along with other players, is involved in setting up hydrogen refueling infrastructure, leveraging its existing network of fuel stations.

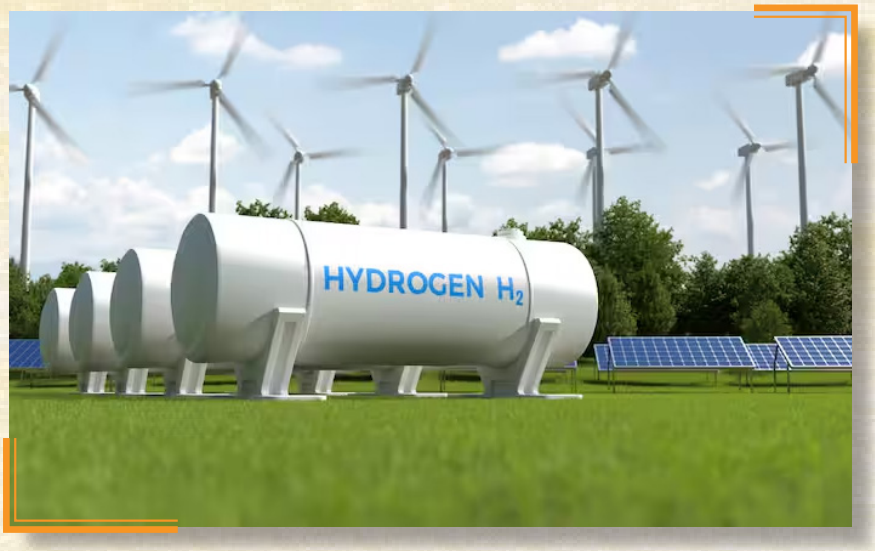
o Industry Research Initiatives:

o IOCL is heavily invested in R&D related to green hydrogen, focusing on cost-effective electrolyzers, advanced storage, infrastructure compatibility, and fuel cell technologies, and CCUS technologies.

o Other Indian companies such as Reliance Industries & Adani Enterprises and research institutions are also actively involved in R&D, focusing on various aspects of the green hydrogen value chain.

Research and Development:

Ongoing research is focused on improving the efficiency and reducing the cost of electrolyzers, fuel cells, and hydrogen storage technologies. Scientists are exploring new materials for electrolyzers, fuel cells, and storage systems to enhance performance and durability. Developing comprehensive safety standards and protocols for handling, storing, and transporting hydrogen is crucial for ensuring its safe and widespread adoption.



India's commitment to green hydrogen, with contributions from a wide range of Indian industry players, is not just about reducing emissions; it's about building a new energy economy that is sustainable, secure, and globally competitive.

E. Other Emerging Technologies

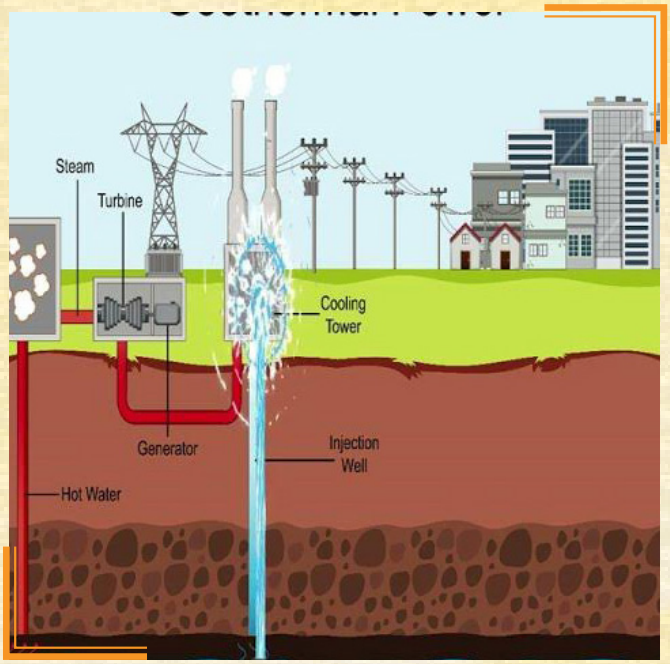
Beyond green hydrogen, India is actively exploring a range of other emerging technologies that hold the potential to further diversify its renewable energy portfolio and enhance its energy security.

1. Tidal Energy:

India possesses significant tidal energy potential along its coastlines, particularly in regions with high tidal ranges. Tidal energy offers a predictable and reliable source of renewable energy, complementing the intermittent nature of solar and wind power. Pilot projects and feasibility studies are being conducted to assess the technical and economic viability of tidal energy development. Challenges include high initial capital costs and the environmental impact on marine ecosystems.

2. Geothermal Energy:

India has identified potential geothermal energy resources in regions with volcanic activity, such as the Himalayas and the Cambay Basin. Geothermal energy can provide baseload power and heating solutions, offering a stable and continuous energy source. Exploration and development of geothermal resources require specialized expertise and technology. Challenges include the high cost of drilling and the potential for environmental impacts.



3. Ocean Thermal Energy Conversion (OTEC):

OTEC utilizes the temperature difference between warm surface seawater and cold deep seawater to generate electricity. India, with its long coastline and tropical climate, has potential for OTEC development, particularly in its island territories. OTEC offers a clean and continuous source of energy, but its commercial viability is still under evaluation. Challenges include the high capital costs and the need for specialized infrastructure.

4. Advanced Biofuels:

India is investing in research and development of advanced biofuels, such as cellulosic ethanol and algae-based biofuels, which offer sustainable alternatives to fossil fuels. These biofuels can be produced from non-food feedstocks, reducing competition with food crops and minimizing environmental impacts. Advanced biofuels can be used in existing transportation infrastructure, facilitating a smooth transition to cleaner fuels. Challenges include the high production costs and the need for technological breakthroughs.

5. Carbon Capture, Utilization, and Storage (CCUS):

Although not strictly a renewable energy source, CCUS technologies play a crucial role in mitigating carbon emissions from industrial processes and power plants. India is exploring CCUS technologies to reduce its carbon footprint and achieve its climate goals. CCUS involves capturing carbon dioxide emissions, transporting them, and storing them underground or utilizing them for industrial purposes. Challenges include the high cost of CCUS technologies and the need for secure and long-term storage sites.

Many of these emerging technologies are still in the early stages of development and require further research and development. Achieving cost competitiveness with conventional energy sources is crucial for the widespread adoption of these technologies. Supportive policies and regulations are needed to encourage research, development, and deployment of these emerging technologies. Careful assessment of the environmental impact of these technologies is essential to ensure their sustainability.

Impact & Sustainability

A. Environmental Benefits & Climate Change Mitigation:

India's commitment to renewable energy is a powerful force in combating climate change and fostering a healthier environment. By shifting away from fossil fuels, the nation is reaping significant environmental rewards.

1. Reducing Greenhouse Gas Emissions:

The most critical benefit of renewable energy is its role in drastically reducing greenhouse gas (GHG) emissions. Solar, wind, and hydropower, the primary drivers of India's renewable energy growth, generate electricity with minimal to no direct GHG emissions during operation. By replacing coal-fired power plants, which are major emitters of carbon dioxide (CO_2), India is making substantial progress in mitigating climate change. This reduction in CO_2 emissions contributes to slowing down global warming, lessening the severity of extreme weather events, and protecting vulnerable ecosystems.

2. Improving Air Quality:

Fossil fuel combustion is a major source of air pollutants, including particulate matter, sulphur dioxide, and nitrogen oxides. Renewable energy sources significantly reduce these pollutants, leading to cleaner air and improved public health. This is particularly important in urban areas, where air pollution can have severe health consequences, causing respiratory problems and other illnesses. Cleaner air translates to healthier communities and a reduced burden on the healthcare system.

3. Conserving Water Resources:

Conventional thermal power plants, especially coal-fired plants, consume vast amounts of water for cooling. Many renewable energy technologies, such as solar photovoltaic (PV) and wind, require significantly less water or no water at all for operation. This water conservation is crucial in a country like India, where water scarcity is a growing concern. By reducing water consumption in the energy sector, India can ensure the availability of water for other essential needs, such as agriculture and domestic use.

4. Protecting Ecosystems:

The extraction and combustion of fossil fuels can damage ecosystems and biodiversity. Renewable energy projects, when planned and implemented responsibly, can minimize environmental impacts and protect natural habitats. For example, floating solar installations can reduce water evaporation and create habitats for aquatic life. By transitioning to renewable energy, India can help preserve its rich biodiversity and protect its natural heritage.

5. Contributing to Global Climate Goals:

India's ambitious renewable energy targets and its progress in deploying clean energy technologies are contributing to global efforts to combat climate change. By demonstrating its commitment to a low-carbon future, India is inspiring other nations to act and accelerate the global energy transition. This collective effort is essential for achieving the goals of the Paris Agreement and limiting global warming to safe levels.

B. Socio-Economic Impact & Job Creation: Powering India's Future

The renewable energy revolution in India is not just about clean power; it's also a powerful engine for socio-economic development, creating jobs, boosting rural economies, and improving the lives of millions.

1. Job Creation Across the Value Chain:

- **Manufacturing:** The growth of the renewable energy sector is driving the establishment of new manufacturing facilities for solar panels, wind turbines, and other components, creating jobs for skilled and semi-skilled workers.

- **Project Development and Construction:** The development and construction of solar and wind farms require a large workforce for site preparation, installation, and commissioning.

- **Operations and Maintenance (O&M):** The long-term operation and maintenance of renewable energy projects create ongoing employment opportunities for technicians, engineers, and support staff.

- **Ancillary Industries:** The growth of the renewable energy sector is also stimulating the growth of ancillary industries, such as logistics, transportation, and consulting, creating additional jobs.

- **Rooftop Solar and Distributed Generation:** The growth of rooftop solar and distributed generation is creating opportunities for small businesses and entrepreneurs in installation, maintenance, and related services.

2. Rural Economic Development:

- **Decentralized Energy Access:** Renewable energy projects can bring electricity to remote and underserved rural areas, providing access to essential services such as lighting, water pumping, and communication.

- **Agricultural Productivity:** Solar-powered irrigation pumps and cold storage facilities can enhance agricultural productivity and improve farmers' incomes.

- **Rural Industrialization:** Renewable energy can power small-scale industries and businesses in rural areas, creating new economic opportunities and reducing migration to urban centers.

- **Skill Development and Entrepreneurship:** The renewable energy sector is creating opportunities for skill development and entrepreneurship in rural areas, empowering local communities.

3. Improved Livelihoods and Quality of Life:

- **Affordable and Reliable Electricity:** Access to affordable and reliable electricity improves the quality of life for households and businesses, enabling access to education, healthcare, and other essential services.

- **Reduced Energy Costs:** Renewable energy can reduce energy costs for households and businesses, freeing up resources for other essential needs.

- **Improved Health Outcomes:** Reduced air pollution leads to improved public health outcomes, lowering healthcare costs and increasing productivity.

- **Enhanced Energy Security:** Renewable energy reduces reliance on imported fossil fuels, enhancing energy security and reducing vulnerability to price fluctuations.

4. Skill Development and Training:

The renewable energy sector is creating a demand for skilled workers in various fields, including engineering, technology, and project management. The government and industry are investing in skill development and training programs to prepare the workforce for the growing renewable energy sector. This is creating opportunities for young people and empowering them to participate in the clean energy transition.

SDI-B: A Catalyst for Bridging the Industry Skill Gap

The Skill Development Institute, Bhubaneswar (SDI-B), plays a pivotal role in addressing the significant skill gap in India's Renewable energy sector. By partnering with industry giant Schneider, SDI-B offers **Solar PV Installer** program that align with renewable energy industry needs.

Impact and Results

To date, 145 students have successfully completed this industry-relevant course, underscoring the effectiveness of SDI-B's training programs. The institute boasts an impressive placement rate of 92%, a testament to the high demand for graduates who are well-prepared to meet the industry's requirements. This success highlights SDI-B's role in shaping a skilled workforce that is ready to contribute to the growth of India's manufacturing and maintenance sectors.

Answer to Cyber Security Quiz

1.B) , 2.B),3.C), 4.D), 5.D), 6.C), 7.B) 8.B), 9.C), 10.B)

SKILL DEVELOPMENT INSTITUTE
BHUBANESWAR
Managed by IndianOil

From Classroom to CAREER

ALUMNI Making Waves

Industrial Automation Specialist Course Completed at
Skill Development Institute, Bhubaneswar

Diptimayee Mantri

Designation: **Machine Operator**
Organization: **Dr.Reddys, Hyderabad**

Skilling Youth, Enhancing Livelyhood !

Solar PV Installer Course Completed at
Skill Development Institute, Bhubaneswar

Somnath Swain

Designation: **Supervisor**
Organization: **Excide Batteries, Bengaluru**

Skilling Youth, Enhancing Livelyhood !

Computer Aided Test Executive(CAE) Course Completed at
Skill Development Institute, Bhubaneswar

Dipak Das

Designation: **CAE Engineer**
Organization: **Designtech system Pvt. Ltd., Chandigarh**

Skilling Youth, Enhancing Livelyhood !

CNC Programmer Course Completed at
Skill Development Institute, Bhubaneswar

Suryakanta Swain

Designation: **Junior Technician**
Organization: **SIEMENS Logistics, Dubai International Airport , Dubai**

Skilling Youth, Enhancing Livelyhood !

Digital Photographer / Camera Operator Course Completed at
Skill Development Institute, Bhubaneswar

Santi Raj Malli

Designation: **Photographer cum Cameraman**
Organization: **Free Lancing**

Skilling Youth, Enhancing Livelyhood !

Graphics Designer Course Completed at
Skill Development Institute, Bhubaneswar

GK Jagat Jyoti Sahu

Designation: **Graphics Designer**
Organization: **Gift Galore, Bhubaneswar**

Skilling Youth, Enhancing Livelyhood !

SKILL DEVELOPMENT INSTITUTE
BHUBANESWAR
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From Classroom to CAREER

ALUMNI Making Waves

Advance Diploma In Automation Course Completed at
Skill Development Institute, Bhubaneswar

Manmath Rout

Designation: **Technician**
Organization:**Dr.Reddys, Hyderabad**

Skilling Youth, Enhancing Livelyhood !

Advance Diploma In Automation Course Completed at
Skill Development Institute, Bhubaneswar

Ramjatan Kumar

Designation: **Junior Engineer Trainee**
Organization: **Jindal Steel and Power Limited. Anugul, Odisha**

Skilling Youth, Enhancing Livelyhood !

CNC Programmer Completed at
Skill Development Institute, Bhubaneswar

Madhabananda Parida

Designation: **DET in Special Process Dept.**
Organization: **Safran Aircraft Engines Pvt. Ltd., Hyderabad**

Skilling Youth, Enhancing Livelyhood !

CNC Programmer Completed at
Skill Development Institute, Bhubaneswar

Bikram Keshari Behera

Designation: **Jr.Engineer**
Organization: **Safran Aircraft Engines Pvt. Ltd., Hyderabad**

Skilling Youth, Enhancing Livelyhood !

Digital Photographer / Camera Operator Course Completed at
Skill Development Institute, Bhubaneswar

Snehashree Priyadarsani

Designation: **Photographer cum Cameraman**
Organization: **M/s Nishant Solution, Bhubaneswar**

Skilling Youth, Enhancing Livelyhood !

Graphics Designer Course Completed at
Skill Development Institute, Bhubaneswar

Aditya Sribastav

Designation: **Graphics Designer**
Organization: **M/s Rising Getanjali Films, Mumbai**

Skilling Youth, Enhancing Livelyhood !

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