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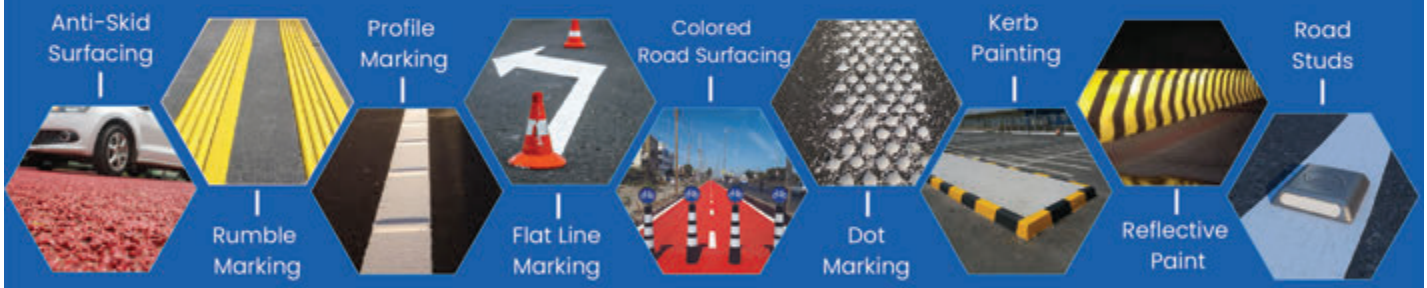

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THE CHIEF EDITOR'S TAKE

Dear Readers,

India, a nation on the cusp of economic and social transformation, is grappling with the twin imperatives of energy security and environmental sustainability. As one of the key signatories of the Paris Agreement, India has embraced the challenge of aligning its growth trajectory with global climate goals. Its burgeoning population and rapid industrialization have driven a surge in energy demand, making the shift toward cleaner energy sources both urgent and essential.

In line with its commitments under the Paris Agreement, India is making significant strides toward expanding its renewable energy sector. The country aims to increase the share of renewables in its power generation mix from 21% in FY24 to 35% by FY30, setting an ambitious target of scaling up its renewable energy capacity from the current 200 GW to over 500 GW by 2030. This rapid expansion aligns with India's broader goal of reducing carbon emissions, producing 5 million tonnes of green hydrogen by 2030, and achieving net-zero emissions by 2070. As India navigates this transformative journey, the cover story explores the future possibilities and the challenges that lie ahead, highlighting the nation's efforts to balance economic growth with environmental stewardship.

In the rapidly expanding renewable energy sector, solar has emerged as the bright spot. As of 2024, the country has commissioned 68.2 GW of utility-scale solar, with another 65.6 GW under pipeline. A report in this edition highlights India's impressive progress in harnessing solar power, driven by technological advancements, government support, and growing demand for sustainable energy.

As countries accelerate their transition to renewable energy sources, integrating efficient energy storage solutions has become paramount. Despite challenges posed by limited domestic reserves of essential materials like lithium and cobalt, recent discoveries and proactive government initiatives signal a promising path forward. An article explores the rise of lithium-ion batteries and emerging alternatives that could redefine the country's mobility landscape.

Leading players and experts from the renewable energy sector have shared their insights on current trends, challenges, and future opportunities in solar power. They also discuss technological innovations, the impact of policy changes, and strategies for accelerating India's clean energy transition.

Apart from these, this edition features engaging articles, case studies, product launches, and the latest developments from the construction, infrastructure, and EPC sectors.

Enjoy the read!

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CLEAN ENERGY

Powering a Nation: India's energy landscape in transition

The country aims to increase the share of renewable energy in its power generation mix from 21% in FY24 to 35% by FY30. This ambitious target requires substantial growth in renewable energy capacity, from the current 200 GW to over 500 GW. EPC World explores the future possibilities…

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Sumadhura Group leases 1.8 lakh sq ft to Nippon Express

Sumadhura Group has announced leasing of 1.8 lakh square feet of warehousing space to global logistics giant NX Logistics India (Nippon Express) at Sumadhura Logistics Park, the largest Grade A warehousing park in Bengaluru. A part of the first phase of Sumadhura Logistics Parks development spanning 2.5 million sq. ft, this collaboration marks one of NX Logistics India's largest warehousing transactions in the country. Sumadhura has entered into a 9-years lease agreement for offering a ready-to-move-in warehousing space at the logistics park to the global logistics player. The Grade A warehousing facility is equipped with state-of-the-art infrastructure and amenities, offering unparalleled convenience, accessibility and top-notch storage solutions to the FMCG clientele of NX Logistics India. Sumadhura Group is investing ₹600 crores in the first phase of Sumadhura Logistics Park, covering around 100 acres of land and offering 2.5 million sq. ft of commercial warehousing space. The company plans to expand the warehousing space to 6 million sq. ft in the next phase.

Sunsure Energy and REC sign MoU for INR 10,000 crores to develop Green Energy Projects

Sunsure Energy has signed a MoU with REC (formerly Rural Electrification Corporation Limited). According to the MoU, REC and Sunsure Energy have agreed to partner for debt financing of INR 10,000 crores to support the development of 3 GW of solar, wind, hybrid, and BESS projects, accelerating India's transition to green power. This partnership will empower Sunsure Energy to significantly expand its portfolio of open access hybrid projects across India, including intrastate solar and solar-wind hybrid projects. By supplying clean energy to commercial and industrial customers, these projects are estimated to offset 5 million tonnes of carbon dioxide annually. This initiative reinforces Sunsure Energy's firm commitment to advancing clean and sustainable energy solutions. Sunsure Energy is currently powering the sustainability journey of over 70 Indian industrial giants across 16 states.

Tata Power Renewable Energy secures 400 MW hybrid project from MSEDCL

Tata Power Renewable Energy (TPREL) has secured a Letter of Award (LoA) from the Maharashtra State Electricity Distribution Company (MSEDCL) for the development of a 400 MW Wind-Solar Hybrid project in Maharashtra. The LoA includes an original contracted capacity of 200 MW, along with a greenshoe option for an additional contracted capacity of 200 MW, making this the largest renewable energy project in state of Maharashtra till date for TPREL. The project is part of MSEDCL's broader initiative to meet the state's Renewable Purchase Obligation (RPO) and address future power demands at competitive tariff. The LoA was issued through a competitive bidding process conducted via an electronically based reverse auction portal. The electricity generated by the hybrid project, which combines solar and wind energy, will be supplied to MSEDCL, aiding the utility company in meeting its energy needs sustainably and enhancing Maharashtra's renewable energy portfolio.

Shyam Metalics commenced Phase I of greenfield cold rolling mill at Jamuria plant, West Bengal

Shyam Metalics and Energy has announced the expansion of its production capabilities with the establishment of a state-of-the-art Greenfield Cold Rolling Mill (CRM) in Jamuria, West Bengal. This strategic investment highlights Shyam Metalics' commitment to enhancing its product portfolio and extending its reach in both domestic and international markets. The facility commenced trial run under Shyam Metalics Flat Products, a wholly owned step-down subsidiary of SMEL. It is in line with government industrial policies and supports the company's strategic strategy. With a total capacity of 400,000 tons annually, the new Cold Rolling Mill is a cutting-edge establishment. The project has a total capital cost of ₹603 crores, with ₹346 crores invested and ₹257 crores pending. The mill will specialize in producing pre-painted galvalume coils (PPGL) and coils of galvanized iron/galvanized steel (GI/GL). With this expansion, Shyam Metalics will be able to produce steel products of the highest caliber and further strengthen its integrated steel manufacturing capabilities. Shyam Metalics' new Cold Rolling Mill will support housing, warehousing, and industrial sheds, with a particular emphasis on affordable housing through initiatives such as PMAY.

Ramco Cements gets National Award for Excellence in Energy Management

The Ramco Cements, Jaggayyapet plant near Vijaywada has bagged 'Excellent Energy Efficient Unit" award in the 25th National Award for Excellence in Energy Management 2024. This award from the Confederation of Indian Industry (CII) is based on the evaluation by the panel of Judges at the National Award for Excellence in Energy Management held during 10th to 12th September 2024 at Hyderabad. Ramco Cements, Jaggayyapet plant was adjudged as 'Excellent Energy Efficient Unit' among 26 shortlisted entries comprising of major Cement Manufacturing Companies.

Silvio Munhoz appointed MD of Scania India

Scania India has appointed Silvio Munhoz as the new Managing Director. Silvio succeeds Johan P Schlyter, bringing decades of extensive experience in the automotive industry to his new role. Silvio's leadership journey includes key positions such as Managing Director of Codema, and interim President and CEO of Scania Brazil. Throughout his career, he has demonstrated a strong strategic vision, a customer-centric approach, and a deep commitment to sustainable innovation, driving success across multiple markets. His appointment marks a new chapter in Scania India's growth, as the company continues to focus on delivering state-of-the-art transport solutions and reinforcing its sustainability initiatives in the region. Under Silvio's leadership, Scania India is poised to continue its commitment to providing complete solutions to the transport and energy industries in India comprising premium products and services.

L&T carves out Renewable Business Vertical

Larsen & Toubro has carved out a separate business vertical for Renewable EPC out of its Power Transmission & Distribution business, within its Infrastructure Projects segment. Clean energy transition has accelerated in recent years with decarbonized electricity being central to the fight against climate change. The rapid technology development in renewable generation has facilitated this trend. Renewable penetration, particularly in solar and wind generation, is set to grow in the global mix. New drivers of electricity demand growth are emerging with stringent reliability and power quality requirements. The spatial and temporal variability of renewable energy sources necessitate a hybrid approach of combining different sources and addition of energy storage devices, so that the supply is dispatchable on demand, any time of the day, throughout the year. In addition to energy-only markets, innovative market structures like capacity market and flexibility market are set to evolve. There is a strong momentum in India's pursuit of promoting renewable energy especially towards increasing the share of non-fossil fuels-based electricity.

Tata Steel commissions blast furnace at Kalinganagar

Tata Steel has successfully commissioned India's largest blast furnace at Kalinganagar, Odisha. With a total investment of ₹27,000 crore, the Phase II expansion at Kalinganagar will take the total capacity at the site from 3 million tonnes per annum (MTPA) to 8 MTPA. The new blast furnace will significantly boost the plant's overall production capabilities, allowing Tata Steel to meet the growing demands of various industries, including automotive, infrastructure, power, shipbuilding, and defence. It will also provide advantages in specific areas like oil & gas, lifting & excavation, and construction. The new blast furnace, with a volume of 5,870 m3, is equipped with state-of-the-art features for long campaign life and an eco-friendly design to optimise the steelmaking process. This blast furnace will utilise four top combustion stoves, along with two preheating stoves for optimum specific fuel consumption in hot metal production. In a first for Tata Steel, a dry gas cleaning plant has been installed to maximise energy recovery from by-product gas. The world's largest Top Gas Recovery Turbine (TRT) of 35 MW power generation capacity will help with the recovery of an additional 10 percent of energy. An evaporative cooling system is being employed for the first time in an Indian blast furnace, optimising space footprint while lowering specific water and power consumption by approximately 20 percent compared to conventional designs. The blast furnace will also have a zero-process water discharge plan with rainwater harvesting.

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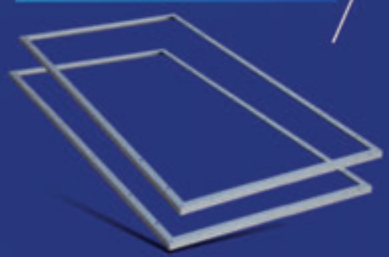

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KEC International wins new orders of ₹1,003 crores

KEC International has secured new orders of ₹1,003 crores across its various businesses. The Railways business has secured an order for Tunnel Ventilation system and associated works in India. The Civil business has secured an order in the industrial segment for Civil and Mechanical works for a Steel plant in India. The Cables business has secured orders for supply of various types of cables in India and overseas.

Tufwud unveils FD120 ID fully insulated fire door

Tufwud has launched FD120 ID—ISI-marked India's first fully insulated fire door. This ground breaking product sets a new benchmark in fire safety by combining aesthetics, functionality, and robust protection. The FD120 ID is the first fire door in India to achieve the esteemed ISI certification, making it a critical line of defense in fire emergencies. The ISI mark, a hallmark of quality and safety in India, guarantees that the FD120 ID meets the highest standards and has undergone exhaustive testing to prove its reliability in real-world conditions. This offering is a testament to Tufwud's mission to safer buildings that include acoustic fire doors, glazed fire doors, lead-lined doors. Tufwud's FD120 ID offers builders, architects, and property owners a solution that not only meets but exceeds current fire safety standards. As fire safety becomes a necessity rather than a luxury, the FD120 ID provides unparalleled protection without compromising on design or functionality.

Jindal India Renewable Energy forays into battery energy storage systems

Jindal India Renewable Energy has forayed into the Battery Energy Storage Systems (BESS). The company plans to build 1 GWh battery pack assembly line with LFP chemistry by 2025 and will foray into battery cell manufacturing with 5 GWh capacity by 2027. To achieve this, the company will be entering into a Technology Collaboration with a world-class technology provider to achieve highest quality standards. This move aligns with India's efforts to strengthen its position as one of the top renewable energy players in the world. This announcement comes in the backdrop of Jindal India Renewable Energy (JIRE) aiming to generate 5 GW of power from solar, wind, hybrid and FDRE modes. Along with this, going forward JIRE will also manufacture PV Cells and Modules to tap into the solar demand. Currently, the sector is witnessing rapid growth due to policy emphasis on renewables to enable the Government's push towards a greener future BESS as a technology enables grid stability, efficient storage and most importantly, addresses the issue of power supply during peak periods and to fulfil the FDRE / RTC demand, and is expected to power India's renewable energy aspirations.

JSW Energy commissions 300 MW Wind Power Capacity awarded under SECI-X

JSW Energy has announced, that its step-down subsidiary, JSW Renew Energy Two Limited, has successfully completed commissioning for the 300 MW ISTS-connected wind power project awarded by Solar Energy Corporation of India (SECI) tranche X located at Tuticorin, Tamil Nadu. This marks the first-ever greenfield wind power plant commissioned by the company for SECI. The newly commissioned wind power project will contribute significantly to our renewable energy portfolio, supporting our vision of a greener and sustainable future. The additional 150 MW of wind capacity awarded under SECI Tranche X located at Dharapuram, Tamil Nadu is also nearing completion with 138 MW already commissioned. Subsequent to this, total current installed capacity stands at 7,726 MW while the under-construction capacity stands at 2,114 MW, that is expected to be commissioned by the end of FY 2025. The Company's current installed wind capacity stands at 2,152 MW.

IREDA to raise approximately ₹4500 crore through fresh equity issue

Indian Renewable Energy Development Agency (IREDA) has received approval from the Department of Investment and Public Asset Management (DIPAM) for raising approximately ₹4500 crore through fresh equity issue. The approval was granted by DIPAM based on the recommendations of a High-Level Committee. The fund-raising will be carried out through the Qualified Institutions Placement (QIP) route, with a planned dilution of the Government of India's shareholding in IREDA by up to 7 percent on a post-issue basis, to be executed in one or more tranches. The fund-raising exercise aims to strengthen IREDA's capital base, enabling the organization to scale its financing for renewable energy projects and further accelerate India's transition to clean energy.

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Nitin Gadkari lays the foundation stone for two NH projects in Pune

Union Minister for Road Transport and Highways, Nitin Gadkari has laid the foundation stone for two National Highway projects in Pune, Maharashtra. These include the four-laning of a 13 km stretch from Dive Ghat to Hadapsar on the Mohol-Alandi section of NH-965 (Palkhi Marg Package VI) and the construction of major bridges on the Mula-Mutha River along with service roads from Sinhagad Road to Warje on the Pune-Satara section of NH-48. Nitin Gadkari said that the widening and upgradation of Hadapsar to duve Ghat section of NH-965 is going to play major role in reducing congestion on this section. It will also help the devotees for a safe and pleasant journey in Palkhi Yatra. He informed that Elevated Corridors of Talegaon Chakan Shikrapur section of NH-548D and Pune-Shirur section of NH-753F will be developed by MSIDC. These projects aim to enhance connectivity between Pune, Satara, and Solapur, providing a smoother journey for devotees travelling to the sacred temple of Lord Vitthal. Additionally, the stretches will facilitate faster travel, alleviate traffic congestion, and boost local economies.

Godrej & Boyce commissions 25MW ground- mounted solar project in Maharashtra

Godrej & Boyce has announced the commissioning of a 25MW AC ground-mounted solar project in Dhule, Maharashtra for the Maharashtra State Power Generation Company. This expansive installation, spanning over 52 hectares, is set to generate an impressive 45 million units annually. The solar plant will supply power to the open market, contributing to Maharashtra's renewable energy ambitions. One of the unique aspects of this project is the innovative value engineering employed to overcome the challenges of undulated land and hard soil strata. Custom-designed structures with varied heights and wind resistance capabilities were designed to ensure maximum efficiency, despite the complex topography. This large-scale project, which enhances Mahagenco's total capacity to 428.02 MW, highlights the adaptability and technological strength of the business in executing challenging solar installations.

Inox Wind signs a consortium agreement with banks for ~ ₹2,200 cr facilities

Inox Wind (IWL) has signed a consortium agreement with a group of banks led by ICICI Bank for limits of ~ ₹2,200 crores. This limit is likely to be enhanced further to ~ ₹2,400 crores as per the working capital assessment done by the lead bank (ICICI Bank). The limits extended are largely non-fund based [bank guarantees (BGs) and letter of credits (LCs)]. The limits have been sanctioned on the financial strength of IWL's balance sheet and without the requirement of any corporate guarantees or any other support from Gujarat Fluorochemicals Ltd. (GFL). IWL's recent fund raises as well as its operational ramp up have led to its balance sheet becoming net cash positive. With this arrangement in place, any prior corporate guarantee or any other such support extended to IWL by GFL stands vacated / to be vacated in the near future.

Highway Infrastructure Trust awarded TOT bundle 16 for ₹6,661 crores

NHAI has awarded Toll, Operate and Transfer (TOT) bundle 16 for ₹6,661 Crores. The financial bids for TOT Bundle-16 were for a 251 km long stretch on the Hyderabad-Nagpur corridor of NH-44 in the state of Telangana and it has been awarded to Highway Infrastructure Trust for ₹6,661 crores. The concession period of TOT bundle is for 20 years in which Concessionaire will be required to maintain and operate the stretch. In lieu of this, Concessionaire will collect and retain user fee for the stretch in accordance with prescribed fee rates under NH Fee Rules. The TOT model has been developed to encourage private participation in the Highway sector. NHAI from time to time has awarded contracts for tolling, operation and maintenance of various National Highway stretches on Toll, Operate Transfer basis. In FY 2023-24, NHAI awarded Four TOT bundles worth ₹15,968 crores against the monetization target of ₹10,000 crores for that fiscal.

Goodluck India inaugurates its ₹200 Crore hydraulic tubes manufacturing unit

Goodluck India has inaugurated its hydraulic tubes manufacturing plant having an installed capacity of 50,000 MT at Bulandshahr in Sikandrabad at an estimated investment of over ₹200 crore. The highly specialised hydraulic tubes, which will find applications in construction machinery, light commercial vehicles and other industrial equipment, will act as a replacement for seamless tubes and help substitute imports. Hydraulic tubes, being a very specialised and niche product, will command a premium and help shore up the company's margins. The company is also looking to export nearly 40 per cent of its total production from the plant in markets such as US and Europe where there is a good demand.

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Jakson Group unveils next-generation CPCB IV+ compliant gensets powered by Cummins, in Varanasi

Jakson Group has introduced the next-generation CPCB IV+ compliant gensets, powered by Cummins, in Varanasi, Uttar Pradesh. Cummins launched CPCBIV+ compliant genset engines for India market. Poised to elevate industry standards, the Cummins-powered CPCB IV+ compliant gensets from the Jakson Group are set to redefine excellence in the backup power solutions industry with their unparalleled features and benefits. Designed to operate under extreme conditions, the CPCBIV+ gensets exceeds reliability expectations with innovations like a next-generation remote monitoring system, an advanced engine control module, and precise fuel level sensors. With enhanced safety features and a low total cost of ownership, these gensets stand out in the market, making it an ideal choice for diverse operational needs. By seamlessly integrating advanced technology with a proven legacy of excellence, this new offering underscores our dedication to superior performance, reliability, and sustainability. As industries evolve and face new challenges, Jakson Group remains at the forefront, providing cutting-edge solutions that redefine the standards of energy for the future, empowering customers globally.

Noida International Airport Partners with Statiq for Airside EV Charging Infrastructure

Noida International Airport (NIA) has announced a strategic partnership with Statiq, India's leading electric vehicle (EV) charging network, to establish extensive airside EV charging infrastructure. Statiq will set up, operate, and maintain the airside electric vehicle charging infrastructure for round-the-clock operations. All concessionaires and airport vehicles will have access to this robust EV charging network, designed to support the airport's sustainability initiatives and reduce emissions across its operations. The collaboration focuses on providing EV charging infrastructure, which will allow all airport partners to deploy electric ground support equipment (GSE) and other electric vehicles within the airport. In the first phase of this partnership, Statiq will install a mix of 7.4 kW AC chargers for smaller electric vehicles, and 120 kW and 240 kW chargers for high-powered, rapid charging needs. Statiq's advanced charging technology will support the airport's ambitious sustainability goals, helping pave the way for a greener future in India's aviation sector.

Om Logistics acquires ICD Bawal for INR 110 crore

Om Logistics has acquired Inland Container Depot (ICD) Bawal in Haryana for a staggering INR 110 crore. This significant investment marks a major milestone in Om Logistics' journey, further solidifying its position as a leader in the industry. Strategically located on the Delhi-Mumbai Industrial Corridor (DMIC) and within the Haryana State Industrial and Infrastructure Development Corporation (HSIIDC) industrial estate, ICD Bawal is a state-of-the-art multimodal logistic hub built on 20 acres of land. The facility features 2 automated rail lines, a 30,000 sq. ft. custom bonded warehouse space and a capacity to handle 5,000 containers of EXIM cargo per month. ICD Bawal boasts exceptional connectivity to major ports, including Mundra, Pipavav and JNPT, ensuring seamless cargo movement. Additionally, its proximity to Indira Gandhi International Airport (DEL) and other airports enables efficient air cargo handling. The depot is also strategically located near NH48 and NH71, providing easy access to northern and western India via road connectivity. Further, ICD Bawal has direct connectivity to the Western Dedicated Freight Corridor (WDFC) and Indian Railways, facilitating swift rail cargo movement. This acquisition enables Om Logistics to expand its PAN India operations, reduce average transit times and optimize supply chain management.

LP Logiscience expands warehousing capacity in Tamil Nadu

LP Logiscience has expanded its warehousing capabilities to Coimbatore, with a state-of-the-art Grade A warehouse. Strategically situated near Madukkarai in Coimbatore, the proposed warehouse spans an impressive 1.3 lakh sq ft, offering a storage capacity of over 15,000 pallet positions. Situated just 1 km from the NH544 Bypass, this meticulously crafted location is strategically designed to cater to diverse industries, providing them with reliable, streamlined, and eco-friendly storage and logistics solutions. LP Logiscience's new facility is equipped to meet the growing demands of the smart city. JLL India is the transaction partner for the e-warehouse that will be developed by NDR Space. The new warehouse features a height of 12 meters with roof monitors and louvers to ensure optimal ventilation. It is equipped with advanced Fire safety systems, including FRLS cables, flameproof lights, sprinklers, a hydrant system, and beam detectors. Additionally, the facility includes docking stations with hydraulic dock levelers, roof insulation, customized storage solutions with heavy-duty racks and mezzanine storage options, and FM2-grade flooring for durability. To support sustainability, the warehouse also features a rainwater harvesting system and a sewage treatment plant. The facility is also supported with ample parking space for smooth movement of trucks and containers.

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Bharat Petroleum Corporation and IONAGE extend partnership to strengthen India's EV charging ecosystem

Bharat Petroleum Corporation has announced the extension of its partnership with IONAGE, a prominent eMobility service provider based in Bangalore. This strategic collaboration aims to enhance the accessibility and convenience of electric vehicle (EV) charging infrastructure across India, bolstering the nation's shift towards sustainable mobility. IONAGE aggregates charging stations from various Charge Point Operators (CPOs), allowing customers to access a vast network of EV chargers through a single platform, significantly increasing ease of use for EV owners nationwide.

BHEL secures order for 2x800 MW Koderma Supercritical Thermal Power Project

Bharat Heavy Electricals has won an order for setting up a 2x800 MW supercritical thermal power project on EPC basis from Damodar Valley Corporation (DVC). The order for the coal-based project to be set up in Koderma district of Jharkhand, has been awarded through International Competitive Bidding (ICB). Significantly, this is the first 800 MW project of DVC and will be set up adjacent to the existing 2x500 MW units, which were also installed by BHEL on EPC basis. BHEL's scope of work for this project includes supply, erection and commissioning, along with civil works. Key equipment for the project will be supplied by BHEL's manufacturing units at Haridwar, Trichy, Bengaluru, Hyderabad, Bhopal and Ranipet, while the execution on site will be undertaken by the company's Power Sector - Eastern Region. The scope also includes highly efficient, state-of-the-art equipment for emission control.

Henkel Adhesives partners with CleanMax for reducing absolute emissions

Henkel Adhesives Technologies India (Henkel India) has partnered with CleanMax (a Brookfield-backed company) to achieve its goal of reducing absolute emissions in its operations. This partnership is a significant step to boost solar power utilisation resulting in additional annual CO_2 savings of over 4500 tonnes in the company's Kurkumbh and Thane manufacturing sites. A Single User Group Captive Solar Power Purchase Agreement (PPA) has been formalised between Henkel India and CleanMax. The captive power project is being set up in a solar farm located in Maharashtra, to be owned and operated by CleanMax. The partnership between the entities is rooted in a shared commitment to sustainable energy usage.

ONGC Videsh, OIL & KABIL sign MoU with IRH, UAE for global cooperation in critical mineral supply chain

ONGC Videsh along with Oil India (OIL), and Khanij Bidesh India (KABIL) has signed a Memorandum of Understanding (MoU) with International Resources Holding RSC (IRH), UAE, to collaborate globally on the Critical Mineral supply chain. The primary goals of this MOU are to identify, acquire, and develop Critical Mineral projects worldwide, including India. The parties aim to leverage their expertise, resources, and networks to pursue mutually beneficial opportunities, achieve operational excellence, and secure a stable supply of critical energy minerals. The MoU outlines a cooperative and coordinated approach, focusing on project identification, joint due diligence, risk management, and developing a long-term offtake strategy.

Apraava Energy bags green energy transmission project in Rajasthan

Apraava Energy has secured a new interstate transmission project in Rajasthan through the government's Tariff-based Competitive Bidding (TBCB) process. The project involves the setting up of ~200 km of 400 kV and 765 kV transmission lines, along with a 765/400 kV, 4x1500 and 400/220 kV, 5x500 MVA pooling station. This project is part of the interstate green energy corridor and will play a vital role in facilitating the evacuation of 5.5 GW of renewable power from Rajasthan's Renewable Energy Zone Phase IV, covering the Jaisalmer and Barmer regions. The project-specific Special Purpose Vehicle (SPV) was recently handed over to Apraava by REC Power Development and Consultancy. As part of the Transmission Service Agreement (TSA), the project will be developed by Apraava under the BOOT (Build, Own, Operate, and Transfer) model, providing transmission services for a period of 35 years once operational. The project is expected to create over 1000 direct and indirect jobs during its two-year construction phase. In its 35-year operational period, the project will provide substantial direct and indirect employment opportunities.

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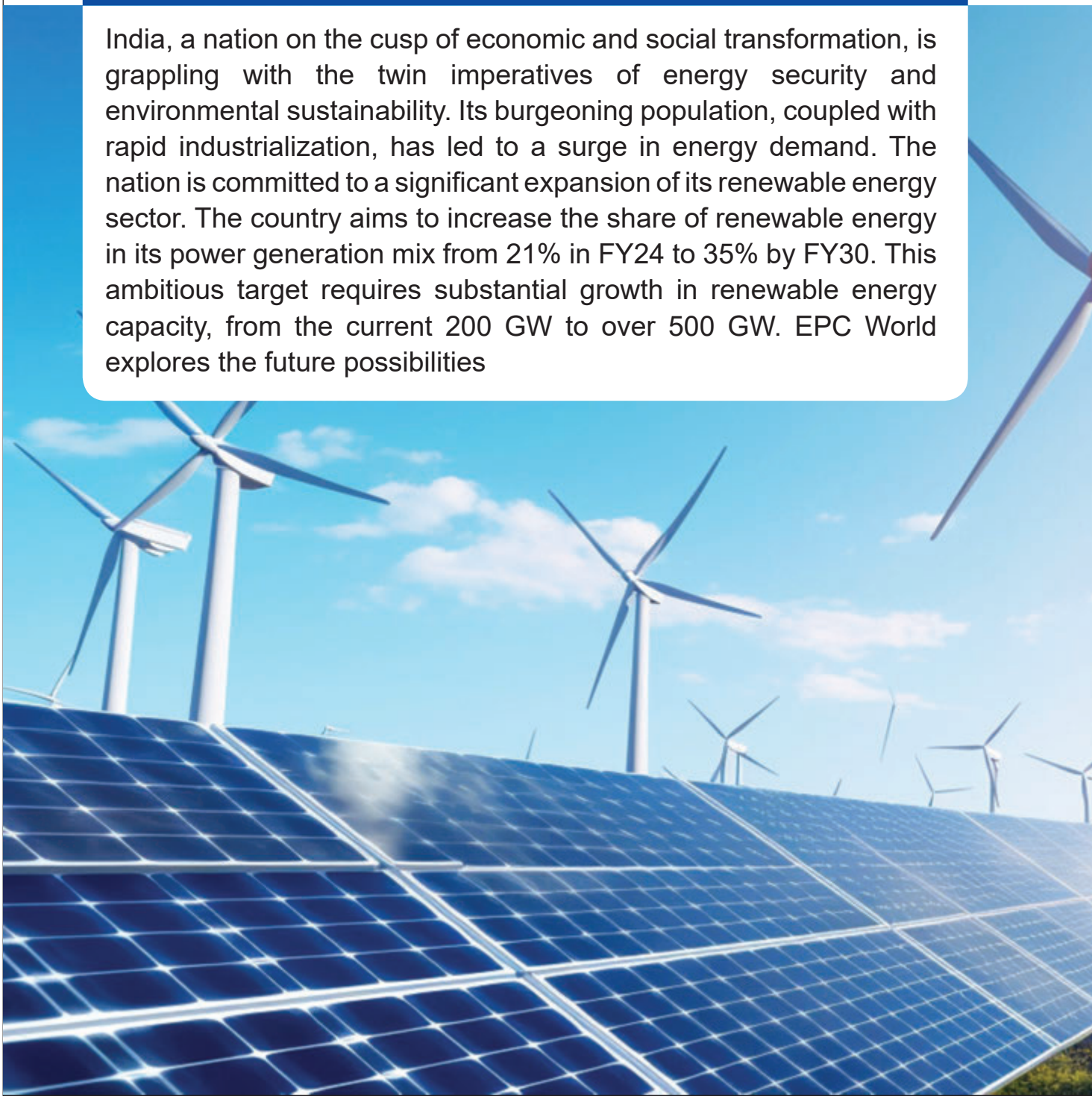
Powering a Nation

India's Energy Landscape in Transition

India, a nation on the cusp of economic and social transformation, is grappling with the twin imperatives of energy security and environmental sustainability. Its burgeoning population, coupled with rapid industrialization, has led to a surge in energy demand. The nation is committed to a significant expansion of its renewable energy sector. The country aims to increase the share of renewable energy in its power generation mix from 21% in FY24 to 35% by FY30. This ambitious target requires substantial growth in renewable energy capacity, from the current 200 GW to over 500 GW. EPC World explores the future possibilities



Ensuring a consistent and affordable energy supply is paramount for India's continued growth. Thermal power plants, fueled by coal, gas, or lignite, currently contribute over 64% of the country's electricity generation. However, their dependence on fossil fuels raises concerns about greenhouse gas emissions and air pollution. India is the world's second-largest coal consumer, and coal-fired plants are a significant contributor to air pollution, impacting public health.

Recognizing these limitations, India is witnessing a significant shift towards renewable energy sources. As of April 2024, the country's installed renewable energy capacity stands at over 160 GW, with solar and wind power leading the charge. The government's ambitious target of achieving 500 GW of non-fossil fuel-based energy capacity by 2030 reflects a strong commitment to clean energy. Policy measures like production-linked incentives (PLI) schemes for solar module manufacturing and concessional finance for renewable energy projects are accelerating this transition.

Navigating the Integration Challenge: Smart Grids and Energy Storage

Integrating a diverse range of renewable energy sources into the existing grid presents a major challenge. The intermittent nature of solar and wind power requires efficient storage solutions and grid management strategies. Advancements in battery storage and smart grid technologies offer promising solutions. Energy storage systems, such as large-scale lithium-ion batteries, can help bridge the gap between periods of high renewable energy generation and peak demand.

Smart grids, equipped with real-time data analysis, automation, and bi-directional power flow, can optimize distribution and transmission, minimizing energy losses and facilitating a more responsive grid. The rollout of smart meters, a key component of smart grids, is already underway in pilot projects across India.

Renewable energy target: India aims to increase the share of renewable energy in its power generation to 35% by FY30.

Current share: The current renewable energy share is 21% in FY24.

Capacity expansion: Achieving this target will require more than doubling the current renewable energy capacity of 200 GW.

Challenges and opportunities: The growing renewable energy sector presents both challenges and significant investment opportunities, especially as the demand for cleaner energy sources intensifies.

India's Green Hydrogen Ambitions

India has set a bold target of producing 5 million metric tonnes (MMT) of clean hydrogen by 2030. To achieve this, the country aims to build an electrolyzer manufacturing capacity of 40GW by the same year. The nation has also a bold step towards clean energy leadership with the launch of its National Green Hydrogen Mission. This ambitious initiative aims to establish India as a global hub for green hydrogen production, backed by a massive investment of ₹10.6 lakh crore (around $129 billion) by 2030.

Green hydrogen, produced using renewable energy sources like solar and wind power, presents a clean fuel alternative with the potential to decarbonize various industries. From transportation and steelmaking to fertilizers and chemicals, green hydrogen offers a path towards a more sustainable future.

The success of this mission hinges on several crucial factors. First, India needs to achieve a significant increase in its renewable energy capacity. This translates to an ambitious target of 135 GW of additional renewable energy generation to meet the production requirements for green hydrogen. Additionally, advancements in electrolyzer technology, which are the machines used to produce green hydrogen from water using renewable electricity, are essential. Finally, developing a robust hydrogen infrastructure for transportation and storage will be critical for widespread adoption.

This mission presents not only environmental benefits but also economic opportunities. By becoming a leader in green hydrogen production, India can attract significant investments and create new job markets within the clean energy sector. However, challenges remain. Ensuring the cost-effectiveness of green hydrogen compared to traditional fuels and fostering collaboration between government, private sector, and research institutions will be crucial for the mission's success.

Overall, India's National Green Hydrogen Mission represents a significant commitment to clean energy and a potential game-changer in the global fight against climate change. By investing heavily in green hydrogen, India is not only aiming for a cleaner future but also positioning itself as a leader in the burgeoning clean energy market.

MNRE Achievements during 100 Days of the Government

- 6.0 GW RE capacity commissioned between June, July, and August 2024 against the target of 4.5 GW.
- Non-Fossil Installed Capacity reached 207.76 GW.
- From June 2024 to August 2024, REIAs have issued RE power procurement bids for 14 GW against a Target of 10 GW.
- Two Solar Parks completed.
- 1 Lakh Solar Pumps installed under PM KUSUM.
- Under PM Surya Ghar Scheme, 3.56 lakh Rooftop Solar systems are installed.
- Cumulative 13.8 GW Solar Module production commenced in the Solar PLI Scheme
- Under the National Green Hydrogen Mission 11 companies were selected under the second tranche for electrolyzer manufacturing for a total capacity of 1500 MW/ annum.
- Offshore Wind Scheme approved by the Cabinet on 19.06.2024, RFS issued by SECI.
- IREDA has incorporated a subsidiary "IREDA Global Green Energy Finance IFSC Ltd" in GIFT City.

Source: PIB

India's Green Hydrogen Push

In a significant push for clean energy, India is targeting a massive investment of 10.6 lakh crore (around $129 billion) by 2030 for its National Green Hydrogen Mission. This ambitious plan aims to establish India as a global hub for green hydrogen production. Green hydrogen, produced using renewable energy sources, is a clean fuel with the potential to decarbonize various industries.

The key takeaways are:

- Investment target: 10.6 lakh crore ($129 billion) by 2030
- Goal: Establish India as a global leader in green hydrogen production
- Benefits: Decarbonize various industries with clean fuel

Energy for All: Bridging the Gap

Despite the strides made in renewable energy adoption, ensuring energy for all remains a critical challenge. As of 2021, an estimated 30 million people in India still lacked access to electricity. Initiatives like the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya Scheme), which aims to provide electricity connections to all un-electrified households in India, are crucial in bridging this gap. These programs not only improve living standards in rural and remote areas but also unlock economic opportunities, contributing to inclusive development.

Opportunities in a Booming Sector

India's energy sector presents exciting opportunities for investors and innovators. The growing demand for renewable energy technologies, energy storage solutions, and smart grid infrastructure opens doors for domestic and international players. Additionally, the government's focus on energy efficiency creates demand for energy-efficient appliances and building materials.

A Brighter Future Beckons

India's energy sector is on the cusp of a historic transformation. While thermal power remains a vital source in the near future, the increasing focus on renewable energy, coupled with smart grid technologies, promises a cleaner and more sustainable future. Ensuring energy for all remains a cornerstone of this transformation, as India strives to meet the growing energy demands of its people and propel itself towards a brighter future.

Aspect	Details
Green Hydrogen	Promising solution for decarbonizing sectors like refineries, fertilizers, steel, and heavy-duty transportation. Produced by splitting water using renewable electricity.
National Green Hydrogen Mission (NGHM)	Approved in January 2023 with an initial outlay of ₹19,744 crore.
Funds Allocation	- ₹17,490 crore for incentives on green hydrogen production and manufacturing of electrolysers. * ₹1,466 crore for pilot projects. *- ₹400 crore for research and development (R&D). * - ₹388 crore for other mission components.
Goals	Position India as a key player in green hydrogen production, ensuring energy self-reliance and economic growth.
Expected Outcomes	- Attract ₹8 lakh crore in investments. - Generate 6 lakh jobs. - Reduce reliance on imported natural gas and ammonia, saving ₹1 lakh crore.
Broader Commitment	Achieve net-zero emissions by 2070. 500 GW of installed non-fossil fuel power generation capacity by 2030.

Key Policy and Regulatory Changes

To accelerate renewable energy adoption, India needs to implement several policy and regulatory changes. These include:

- Streamlining land acquisition processes for renewable energy projects
- Strengthening transmission infrastructure to accommodate variable renewable energy
- Enhancing the RECs market to incentivize renewable energy purchase
- Providing concessional financing for innovative renewable energy technologies and storage solutions
- Promoting green hydrogen production
- Investing in skill development for the renewable energy sector
- Encouraging consumer awareness and participation in renewable energy initiatives
- Simplifying the regulatory framework for renewable energy projects
- Implementing a carbon pricing mechanism

By implementing these measures, India can create an enabling environment for faster renewable energy adoption, ensuring a sustainable and equitable energy future for its citizens.

Challenges and Opportunities

Achieving this goal presents several challenges. Land acquisition for large-scale renewable energy projects remains a hurdle, especially in densely populated regions. Grid integration and transmission infrastructure also need to be expanded to accommodate the increased renewable energy generation. Additionally, ensuring the financial viability of renewable energy projects and addressing issues related to intermittency and variability of renewable energy sources are crucial.

Despite these challenges, the renewable energy sector in India offers significant investment opportunities. As the demand for cleaner energy sources grows, there is increasing interest from both domestic and international investors in renewable energy projects. The government's supportive policies, including production-linked incentives (PLI) schemes and concessional finance, further incentivize investments in this sector.

Key Drivers and Future Outlook

Several factors are driving India's renewable energy growth. The government's strong commitment to clean energy, coupled with the increasing affordability of renewable energy technologies, is playing a vital role. Additionally, the growing awareness of climate change and the need for sustainable energy solutions is motivating both public and private sectors to invest in renewable energy.

Looking ahead, India's renewable energy sector is poised for substantial growth. The country's abundant solar and wind resources, coupled with its technological advancements and supportive policies, provide a strong foundation for a sustainable energy future. As India continues to transition towards a cleaner energy mix, it is not only addressing climate change but also creating new economic opportunities and improving energy security. EPC World

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Powering the future

India's strategic leap into Green Hydrogen

India strives to increase green hydrogen production, but cost is a big worry

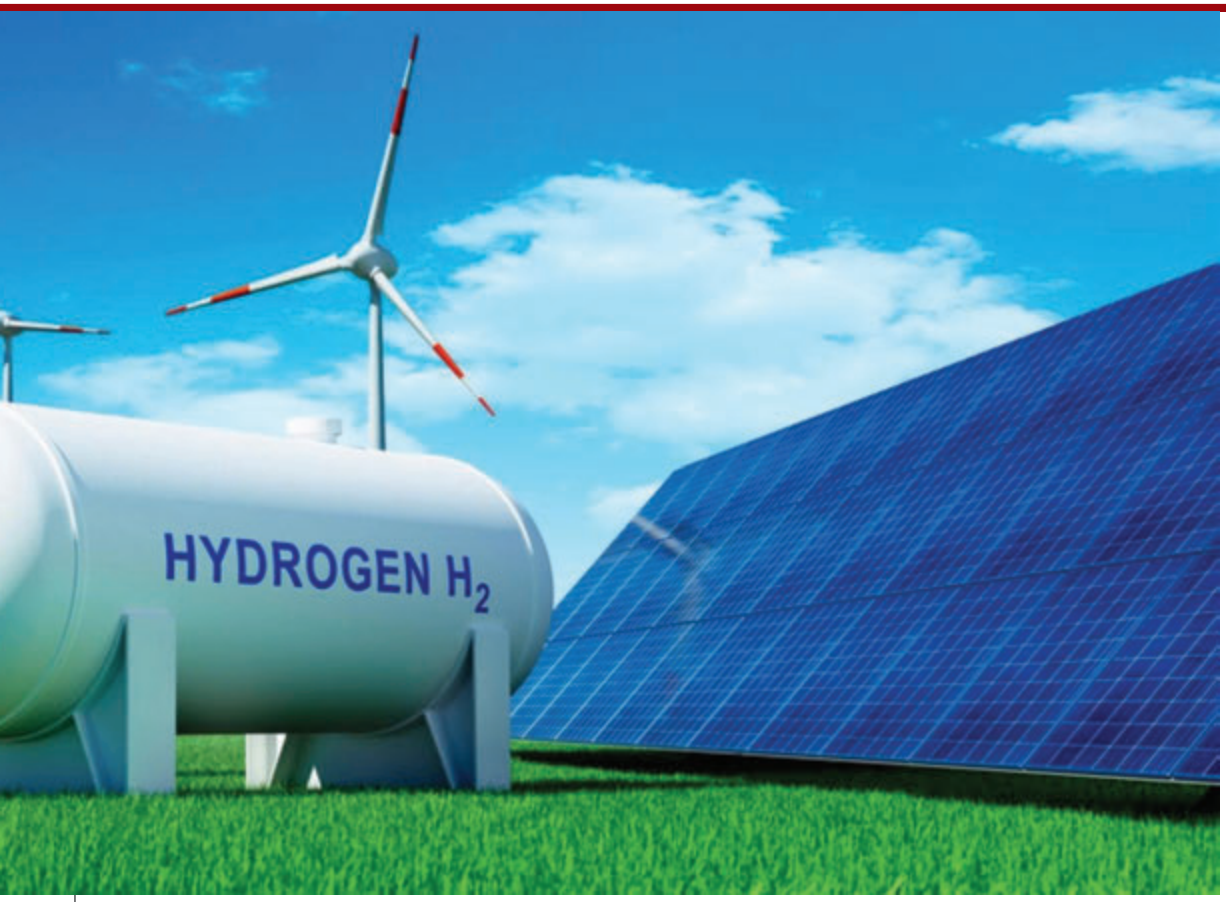
Green hydrogen is emerging as a crucial alternative as the world transitions from fossil fuels to sustainable and cleaner sources of energy. For India, the fuel is a strategic input in its quest for energy security and to meet its net-zero goal. India's journey to becoming a global leader in green hydrogen commenced with the announcement of the National Green Hydrogen Mission (NGHM)in January 2023, underlining the commitment to reduce carbon footprint and enhance energy security. The mission, supported by ₹19,744 crore in financial aid from the government, aims to produce at least 5 million metric tonne (MMT) of green hydrogen, add 125 gigawatts (GW) to the country's renewable energy capacity, attract investments worth ₹8 lakh crore and create 600,000 jobs — all by 2030.

The government has introduced incentive schemes under the Strategic Interventions for Green Hydrogen Transition (SIGHT) programme to accelerate the production of green hydrogen by supporting the setting up of electrolyser manufacturing facilities, ramping up technology, and developing infrastructure and skills. As much as ₹4,440 crore is being allotted under the programme to encourage electrolyser manufacturing capacity. The first phase of the project aims to create 1.5 GW of electrolyser capacity. The auction for this drew participation from 20 companies, which bid 2.2 times the targeted capacity. Contracts were awarded to eight companies, with a maximum incentive allocation of ₹2,220 crore. The second phase, launched in July 2024, that aims to create another 1.5 GW of electrolyser capacity, saw more companies — 23 of them — joining the fray.

In addition, ₹13,050 crore has been allocated for the green hydrogen production scheme. The first phase in this aimed to create 450,000 metric tone (MT) capacity. As many as 10 out of 14 companies were offered support worth ₹3,055 crore to create 412,000 MT of capacity. The second phase, also launched in July 2024, is in progress. If these capacities come on stream as envisaged by 2030, India will be close to having 5 GW capacity.

Refining and fertiliser sectors to lead domestic demand for hydrogen

The government is implementing aggregation schemes for green hydrogen and green ammonia to stimulate demand, particularly in the refining and fertilizer sectors. In refining, green hydrogen is set to transform processes such as hydrocracking and desulfurisation. To incentivize this, a green



hydrogen production aggregation scheme called Mode2B has been initiated,which would help oil and gas companies aggregate demand and invite bids for the production and supply of green hydrogen at the lowest cost.

In July, India issued a tender for the production and supply of 7.4 TPA of green ammonia, one of the largest initiatives of its kind globally. The integration of green hydrogen into ammonia production is expected to significantly reduce emissions and position India as a potential exporter, aligning with broader environmental goals.

India's green hydrogen strategy also encompasses various sectors that contribute to emissions reduction and sustainability. Key end-user industries include shipping, steel, and mobility, where specific schemes have been launched. For instance, a pilot scheme for green hydrogen in ship propulsion has an outlay of ₹115 crore until fiscal 2026. On the other hand, a budget of ₹455 crore until fiscal 2030 has been allocated for a pilot scheme to promote the use of green hydrogen in steelmaking processes. In addition, initiatives to promote research and development have received a significant allocation of ₹400 crore, underscoring India's commitment to advancing technology and facilitating green hydrogen adoption.

Another strategic priority is the establishment of hydrogen hubs and guidelines have been issued to set up two of them to foster innovation and collaboration. In addition, India has published its own green hydrogen standards. A draft certification scheme is currently under public consultation. Also, the government is prioritising skills development within the sector to create a workforce capable of driving the green hydrogen agenda forward.

Cost of green hydrogen poses a challenge

Despite all the initiatives, challenges of cost competitiveness, calibrated investments in the industry, safety concerns and the need for infrastructure investments impede widespread adoption of green hydrogen.

The cost challenge

Green hydrogen is nearly twice as expensive as grey hydrogen derived from fossil fuels — primarily natural gas. This is a significant barrier to adoption. This price disparity is due to high renewable energy costs and the expensive electrolysers needed to produce hydrogen. Further, the cost gap remains unbridged to a great extent despite waiver of inter-state transmission charges and central support.

Sectors wary of adoption

Many sectors remain cautious about adoption also because demand is currently limited to refining, fertilizers and chemicals. There is slower adoption in sectors such as industrial heating, transportation and power generation because of the substantial capital investment required, which casts a shadow on economic viability.

Safety concerns

Hydrogen's high flammability raises worries about explosion risks during storage and transport. In addition, existing pipelines may not be compatible, leading to fears of material degradation and potential failures. Such issues necessitate the development of stringent safety protocols, which can add to costs and deter industries from making the switch to hydrogen-based systems.

Infrastructure investment

For widespread adoption of green hydrogen, significant investments are required to develop storage and refueling facilities, particularly in the transportation sector. As battery electric vehicles gain popularity, the case for a competitive hydrogen infrastructure will improve. The lack of it currently deters industries.

Way forward

To harness the potential of green hydrogen, several steps are underway. India is trying to reduce the costs associated with adoption of green hydrogen through various incentives, including those under the NGHM. State governments also plan additional incentives and support for green hydrogen production and technology development. However, more efforts, such as mandates for usage and investing in local technology to enhance efficiency and reduce reliance on imports, are needed. Strengthening the safety regulations and standards is also vital for mitigating risks and building industry confidence. And fostering public-private partnershipsor facilitating lowinterest rateloans to build infrastructure can accelerate adoption.

Companies explore exports market as global demand evolves

Despite these challenges, green hydrogen presents significant opportunities for India.

• ***Reducing emissions and saving import bills***

One of the main opportunities lies in reducing greenhouse gas emissions in hard-to-abate sectors, such as steel and fertilisers, aligning with India's goal of achieving net zero emissions by 2070. In addition, green hydrogen presents a strategic opportunity for India to reduce its reliance on imported fossil fuels and save precious foreign exchange. By developing a robust green hydrogen infrastructure, the country can improve its energy independence and promote economic resilience.

• ***International ties and export opportunities***

Green hydrogen adoption can help improve international ties, especially with the United States (US) and the European Union (EU). For instance, Ohmium, the US-based company, is setting up an electrolyser manufacturing unit in Karnataka with a capacity of 2 GW. Ditto Reliance Industries, which has partnered with Denmark's Stiesdal. The EU aims to import 10 MTPA of green hydrogen by 2030, which aligns with India's production goal of 5 MTPA, creating a promising export market.

India is at a pivotal moment in its green hydrogen journey. There are strategic opportunities to lower the country's import bill and enhance energy independence. To be sure, there are significant challenges, such as high costs and inadequate infrastructure, which can only be addressedthrough regular collaboration between the government and the private sector. Getting things right will position India as a major player in the global green hydrogen economy. EPC World

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Green hydrogen investments are capital intensive

Implementing green hydrogen solutions faces several challenges, starting with low demand that hampers large-scale investments, **SUBRAMANIAN CHIDAMBARAN,** Director – Corporate Strategy, Cummins India

How can we improve the efficiency of electrolysis to make green hydrogen production more cost-effective?

Electrolysis, the process of splitting water into hydrogen and oxygen using electricity, relies on two key inputs: water and power. To make green hydrogen production more cost-effective, it's essential to address the factors influencing its cost, referred to as the Levelized Cost of Hydrogen (LCOH). LCOH consists of two main components: Operational Expenditure (Opex) and Capital Expenditure (Capex). While Capex covers the cost of setting up a green hydrogen plant, the Opex includes expenses for inputs like water, electricity, and maintenance. The higher the Opex, the smaller the contribution of Capex in LCOH, making operational coststhe critical factors. Efficiency of electrolysis is defined by the number of inputs needed to generate one unit of output. In the case of green hydrogen, it is defined by the amount of water and electric power (energy) required to produce one unit of hydrogen. While energy efficiency is often the focus, water efficiency also plays a significant role but receives less attention.

Coming to energy efficiency, the common misunderstanding is to look at the energy efficiency of the electrolyser cell-stack and evaluate the technology. While it is the major component, the hydrogen plant comprises other equipment such as water purification units, hydrogen purification systems, etc, which all need energy. Improving the overall energy efficiency of electrolysis requires optimizing every unit of the hydrogen plant to be energy efficient. Technologies that consume lesser energy inherently for converting water to hydrogen could be beneficial in reducing the opex cost of hydrogen. Proton Exchange Membrane (PEM) technology was introduced to enhance efficiency over Alkaline technology. Today, solid oxide is touted to be superior to both PEM and Alkaline in its energy efficiency.

Which sector is likely to see the fastest adoption of green hydrogen technology, and why?

Adoption of any new technology depends, according to me, on three factors – technical feasibility, economic viability (at total cost of ownership level) and accessibility/ availability. For industries that have been traditionally using hydrogen for various purposes (eg,

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chemical industry, oil & gas industry, fertilizer industry etc.), technical feasibility of green hydrogen is not a barrier. These sectors will likely adopt green hydrogen more quickly, as they only need to address the other two aspects. Conversely, sectors such as automotive which have not traditionally used hydrogen, need to overcome all three hurdles. This will slow their adoption compared to sectors already familiar with the hydrogen applications.

What are the main challenges in implementing green hydrogen solutions? What policies or incentives could accelerate the development of green hydrogen infrastructure?

Implementing green hydrogen solutions faces several challenges, starting with low demand that hampers large-scale investments. Consumers are waiting for price reduction, but prices will only fall with economies of scale, which in turn requires higher demand. This creates a catch-22 situation. While Production-Linked Incentives (PLI) help, a mandate on green hydrogen use in key industries is necessary to drive demand and encourage investments. Another challenge lies in the variability of power costs across India, particularly for renewable energy (RE). In some regions, RE is expensive, and its intermittent nature necessitates the use of costly battery storage to ensure round-the-clock (RTC) power, crucial for maximizing electrolyzer efficiency. Additionally, ensuring a consistent supply of demineralized water of the required purity for electrolysis will become a growing challenge as production scales up. Currently, most electrolyzer stack technology in India is imported, with indigenous technologies still in the early stages of development. These technologies require opportunities and support from established industries for pilot projects and commercialization. While the supply ecosystem for a lot of the Hydrogen related components (e.g., valves, transformers, rectifiers etc.) is strong, there is a need to develop supplier ecosystems of various other elements (e.g., plates, stacks etc.).

Distribution also presents challenges, as research on using existing gas pipeline infrastructure for hydrogen transportation is inconclusive. This leaves transportation through tanks or localized hydrogen production and consumption as the primary options. However, the technology for high-pressure storage tanks, particularly Type 4 tanks, is still nascent in India and costly. Safety concerns among end consumers are another barrier to large-scale adoption. Despite ongoing efforts to ensure safety at hydrogen production and application sites, public perception remains an issue. Additionally, there is a lack of trained personnel across the hydrogen value chain, particularly in the construction, operation, and maintenance of hydrogen facilities. While some focus is placed on engineering and R&D, more attention is needed to develop a skilled workforce for the sector.

Finally, the green hydrogen sector relies heavily on government support for funding, which is not a sustainable approach given the many competing social and economic priorities in a developing country like India. Although innovative funding mechanisms are being explored in collaboration with banks, non-banking financial companies (NBFCs), and other institutions, more efforts are required to attract investment and accelerate the growth of the green hydrogen sector.

Which countries are leading in green hydrogen development, and what can others learn from their approaches?

Green hydrogen investments are capital intensive, which is why developed economies like Europe and the US are leading compared to other nations. However, each country is making efforts to balance its economic growth, social commitments, and green hydrogen ambitions. European nations are driving decarbonization through carbon taxes and green mandates, creating required market demand and attracting investments in clean energy. This approach is worth emulating as it effectively boosts the market for clean energy technologies. In the US, the Inflation Reduction Act (IRA) has triggered a surge of green hydrogen investments by offering attractive incentives to hydrogen producers. Meanwhile, China is advancing its green hydrogen economy through a structured approach, dedicating specific regions and provinces to develop end-to-end ecosystems. The government is also heavily investing in primary research for various green hydrogen technologies. The 'mega large-scale factory' concept is helping them gain cost advantage on various components of the electrolyser value chain. By combining market incentives, focused investments, and large-scale production, these countries are advancing green hydrogen development. Other nations can learn from their strategies to balance economic growth, social commitments, and sustainability goals. EPC World

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03/2024

Tekla Structures and Trimble Connect are game-changers

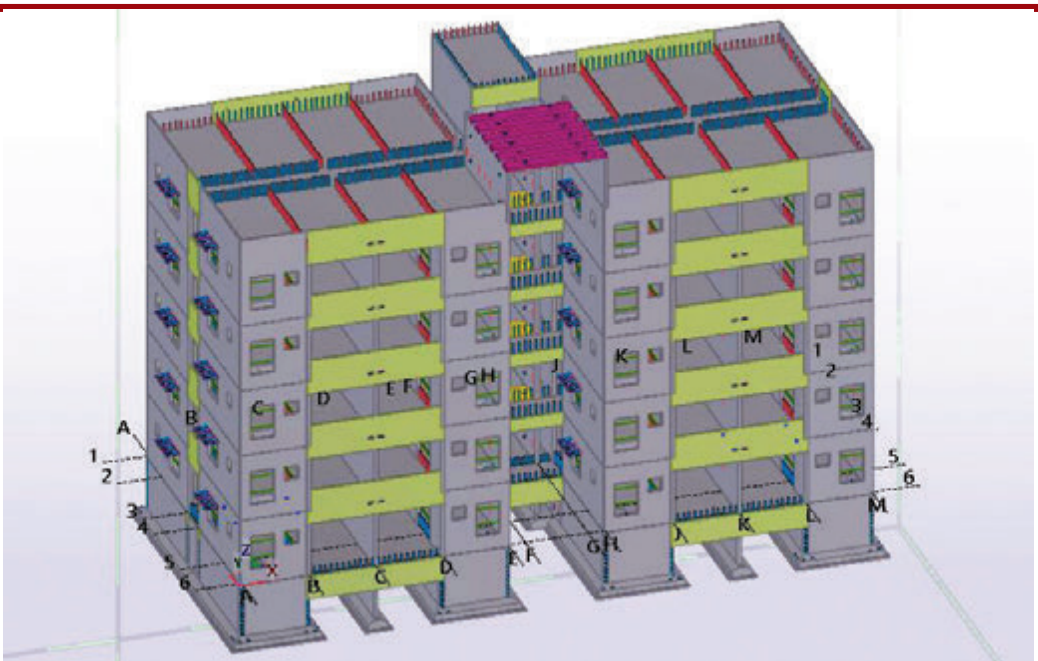
Technology is revolutionising modular construction and Trimble's hardware and software solutions are at the forefront of this transformation, says **HARSH PAREEK**, Regional Sales Director, India and SAARC, Trimble Solutions

How does modular construction contribute to reducing project timelines compared to traditional construction methods, particularly in large-scale infrastructure projects?

Modular construction in fact helps shrink project timelines, while also ensuring top-notch quality of construction in both infrastructure and real estate sectors. Shrinking of timelines is possible because, unlike conventional construction techniques that often involve lengthy sequential processes, modular construction allows for concurrent progress across site preparation and component fabrication. Further, components are crafted off-site under controlled conditions, leading to higher precision and fewer delays. Use of cutting-edge software like Trimble's Tekla Structures enhances this process even further by enabling precise 3D modeling and seamless coordination between off-site fabrication and on-site assembly. This integration not only ensures that modules fit perfectly - resulting in outstanding quality of the finished project – but also that the project's timelines are no longer impacted by external factors like weather conditions, labour shortages, or supply chain disruptions.

What role does technology, such as Trimble's solutions, play in optimising the design and delivery process of modular construction?

Technology is revolutionising modular construction and Trimble's hardware and software solutions are at the forefront of this transformation. Tools like Tekla Structures and Trimble Connect are game-changers in enhancing design accuracy and operational efficiency. Through advanced 3D modeling, Trimble's BIM software ensures every modular component is meticulously designed and errors are caught early in the process, minimising rework. Going further, Trimble Connect synchronises efforts among architects, engineers, and contractors via real-time collaboration, fostering a unified and cohesive approach throughout the project. Additionally, Trimble's machine control systems and geospatial technologies ensure precise module placement and alignment, reducing errors during delivery and assembly. By leveraging these technologies, Trimble significantly boosts modular construction's stability, reduces waste, and accelerates project timelines, driving greater efficiency and cost-effectiveness.



Can you provide examples of projects where modular construction has significantly accelerated completion times, and what were the key factors in achieving this?

Inventaa's use of Tekla Structures for their precast projects is a prime example of how modular construction can significantly speed up project timelines. By implementing Tekla's advanced 3D modeling capabilities, Inventaa was able to meticulously plan and fabricate components in a controlled factory environment. This prefabrication process allowed for rapid on-site assembly, reducing construction time and minimising errors. Key factors in achieving this efficiency included precise planning, high-quality control, and optimised resource usage, demonstrating how integrating innovative technology with modular construction methods can lead to faster and more reliable project completion.

How does modular construction impact project management and coordination across different phases, and what are the benefits in terms of timeline efficiency?

Modular construction transforms project management by enabling multiple phases to progress simultaneously, drastically accelerating overall timelines. Unlike traditional approaches where each phase depends on the completion of the previous one, modular construction allows for concurrent site preparation and module fabrication. This dual-track process minimises idle time and speeds up project completion. Effective coordination between off-site and on-site teams is critical, and modular methods streamline this by standardising components and simplifying logistics. The result is reduced on-site construction time, fewer disruptions, and enhanced project predictability. This approach not only accelerates delivery but also minimises environmental impact, making modular construction a more efficient and sustainable choice.

In your opinion, what are the future trends in modular construction that will further enhance the speed and efficiency of project delivery?

The future of modular construction is poised for exciting advancements that promise to boost speed and efficiency even further. One major trend is the evolution of digital technologies, with Trimble's BIM tools becoming increasingly sophisticated. These advancements provide more detailed and accurate virtual models, improving design precision and coordination. Automation and robotics are set to revolutionise the fabrication of modular components, enhancing both speed and accuracy. Additionally, sustainability will play a crucial role going forward with eco-friendly materials and energy-efficient practices becoming more prevalent. The integration of smart technologies, including IoT-enabled modules and advanced building systems, will offer real-time data and analytics, further optimising efficiency and maintenance. These trends will drive modular construction toward even shorter timelines, reduced costs, and superior quality. EPC World

Brighten The Tomorrows

Solar energy tops as the most consumed renewable source of energy. The sector plays a pivotal role in energizing economic and daily lifestyle of masses and is a critical factor in realizing India's dream to emerge as a Net Zero Carbon emitting nation.

Blessed with a tropical climatic condition, India thankfully enjoys an abundance in solar resource. The sector which was once in its pedestal stage has today spread its reach and is a vital power source even in the tier-II and tier-III regions in India. The gleaming plated surfaces equipped with the ability to generate electricity from sunlight was once a wonder to human minds – showcasing a perfect amalgamation of reality envisioned by exploring the potentials of science. As solar parks and sun-powered generators to heaters to electricity and even vehicles, the potentials of solar energy is thoughtfully explored and is ever expanding. The growing number of population and increased dependence on non-renewable fuel resource, which have a potential threat of being scarcely available for our future generations have further pushed the need to explore renewably available natural resource.

India could be rightfully tagged as one among the innovative frontrunners in exploring the potentials of solar energy. So much that the resource which was once limited to only urban clusters and Smart Cities is today a major power source lighting up even the rural and semi-urban clusters.

The Scoring Statistics

A recent research report by JMK Research & Analytics states, "As of March 31, 2024, about 68.2 GW of utility-scale solar capacity has been commissioned in India, while another 65.6 GW is under pipeline (where auctions are completed). Rajasthan has the maximum installed solar capacity of 19.9 GW followed by Gujarat (10.6 GW) and Karnataka (9.2 GW). In FY2024, about 11.7 GW of utility-scale solar capacity and another 3 GW of rooftop solar capacity were added in India. The top three states with maximum installed solar capacity were Gujarat (4.8 GW), Rajasthan (3.4 GW), and Madhya Pradesh (0.8 GW). For next year i.e. FY2025, about 16.9 GW of new utility-scale solar projects and 4 GW of rooftop/ onsite solar projects are expected to be commissioned."

According to the market outlook shared by a senior analyst, the country's total installation capacity for renewable energy scaled up to 195 GW as of June 2024. Solar alone accounted for about 44 per cent of the total renewable energy capacity utilized making it lead the sector as the largest contributor. The 12,156 MW solar addition in H1 comprises about 9.6 GW of new utility-scale solar, 1.8 GW rooftop, and about 688 MW off-grid installations.

As part of its National Solar Mission, India continued to expand its solar capacity with large-scale solar projects. The government also promoted rooftop solar installations through subsidies and incentives. A recent media report indicated that India has successfully achieved greater momentum in the development of solar power. India now has over 87 GW installed solar capacity, which is over four times what it had wanted to achieve by 2022 – when it launched its National Solar Mission.

Evolving Tech Adoption

Technology plays a crucial role in exploring the potentials of renewable energy. The tech tools and services is one of the core factors which have resulted in solar emerging as a popular choice for an alternate power resource. With the emergence of real-time technologies, Artificial Intelligence has also gained its momentum in the solar sphere. Use of AI tools for machine learning, predictive maintenance, storing and sourcing data and monitoring operations are today fast tracked. The other key trends driving the sector are the use of

Key Solar Parks in India

- Bhadla Solar Park – Rajasthan
- Pavagada Solar Park – Karnataka
- Kurnool Ultra Mega Solar Park – Andhra Pradesh
- Rewa Ultra Mega Solar – Madhya Pradesh
- Kamuthi Solar Power Project – Tamil Nadu
- Mandsaur Solar Park – Madhya Pradesh
- Bhadla Phase-II – Rajasthan
- Charanka Solar Park - Gujarat

bifacial solar panels ensuring increased efficiency, integration of energy storage systems and eco-friendly materials.

A report by Freyr Energy states, "With enhanced efficiency, rapid power restoration, reduced costs, and increased integration of renewable energy, the on-grid solar system paves the way for a reliable, sustainable, and economically viable energy future. It also offers streamlined electricity transmission to lower power rates, improved security, and a more resilient grid that safeguards essential services during blackouts."

Hybrid models are the other driving factor boosting the sector. Exploring the potentials of renewable energy sources, today numerous farms are on a rise which combines the solar and wind energy to produce power resource. The other noteworthy trend are the floating solar plants. The installations set up on water bodies—mainly lakes and reservoirs – is a thoughtful step towards conserving land and curbing water evaporation. The 600 MW floating solar plant at Madhya Pradesh is one-of-its-kind project and is expected to be one of the world's largest such resource. The floating solar plants is a boon for countries with limited land reserves and abundant water bodies.

The development of more efficient and affordable batteries is the other vital aspect for storing solar energy. Technologies such as solid-state batteries and flow batteries are expected to make significant strides in 2024, enhancing the reliability and accessibility of solar power.

Ensuring Good Governance

Support from the Governing authorities play an important role in the success of sector like renewable power and energy. Bundled with complexities like land concerns, cost involvement, environmental regulations and policies – an efficient backing of the Governing bodies is much needed in sectors like solar power. Thanks to the sustainable and eco-efficient mantra being adopted by the Indian Government, the renewable sector is being much promoted today. So much that even the big ticket infra projects like airports, Smart Cities etc. are promoting the adoption of renewable power and energy reserves.

A recent report by Fenice Energy stated, "The government's Production Linked Incentive (PLI) scheme gave a big push with ₹24,000 Crore. The 2023-24 National Budget shows strong support with a 48 per cent funding increase for solar, amounting to ₹7,327 Crore. India has big plans to get half of its electricity from renewables by 2030. It wants 500 GW of renewable capacity by then. India already passed 40 per cent of its power capacity from non-fossil fuels at the COP 21 Paris Summit. India aims to create a big market for green hydrogen, hoping for a 5 million tonnes demand by 2050. This will help avoid 400 million tonnes of CO2. It shows India as a leader in growth, industry, and better life quality without raising its carbon footprint. India is on the edge of a big chance, tapping into an $80 billion renewable batteries and green hydrogen market by 2030. This is backed by the International Energy Agency seeing India as the third biggest ethanol market and a key bioenergy player. To reach a net-zero emission goal by 2030, around $160 billion a year is needed."

The report further added, "India's renewable energy stories aim at energy safety and growth. They call for worldwide action for a sustainable Earth. As India aims to generate over 1,900 billion units of solar power annually, it's focusing on rooftop solar and solar highways. This transforms the Indian solar market into a symbol of sustainable growth. It's also about creating a brighter, cleaner future for everyone."

Home to the world's largest solar park, the Bhadla Solar Park in Rajasthan, India aims to expand its horizons of renewable energy and envisions to soon realize its dream of emerging as a Net Zero Carbon emitting and Energy Independent Self-Reliant Nation.

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Scaling Up Solar: India's Role in Global Energy Shift

India is embarking on a transformative journey towards energy independence, with a strong emphasis on renewable energy, particularly solar power. The government's energy strategy aligns with the nation's long-term goals of sustainability and energy security. At the heart of this strategy is the PM Surya Ghar Muft Bijli Yojana, which promises to revolutionize the solar landscape by distributing rooftop solar panels to one crore families. This scheme guarantees free power for up to 300 units every month, aiming to significantly increase home solar adoption and reduce reliance on traditional energy sources. By encouraging wider adoption, the program contributes to India's overall aim of reaching 500 GW of renewable energy capacity by 2030, as outlined in the Paris Agreement.

Addressing Critical Mineral Dependencies

A significant challenge facing India's renewable energy sector is the reliance on imported critical minerals like lithium, nickel, and cobalt, essential for battery production. These resources are primarily sourced from South America, Africa, China, and Australia, creating vulnerabilities in the supply chain. To mitigate this, the Critical Minerals Mission aims to bolster domestic production, secure international resources, and enhance recycling efforts. Waiving customs duties on 25 critical minerals and reducing duties on key raw materials is expected to stimulate local manufacturing and reduce costs, making renewable technologies economically more viable.

Taxation and Industry Impact

The government's approach to taxation has mixed implications for the solar industry. On one hand, lower customs tariffs on solar panels and cells boost domestic manufacturing. On the other, the increase in customs taxes for solar glass and tinned copper interconnect may affect overall pricing trends. While the industry had hoped for a reduction in GST on wind, battery storage, electric vehicles, and charging stations, these measures have not been implemented.

Empowering Micro, Small, and Medium Enterprises (MSMEs)

Micro, small, and medium-sized enterprises (MSMEs) play a vital role in India's energy transition. These businesses face significant challenges in funding renewable energy projects, which are being addressed with a new credit guarantee system. This initiative aims to prevent MSMEs from becoming non-performing assets (NPAs) and proposes a new credit evaluation model based on digital footprints. Additionally, the plan encourages MSMEs to switch to cleaner energy sources by offering financial assistance for the deployment of clean technology and energy audits.

Investing in Research and Development

Innovation remains a critical component of a successful energy transition. The commitment to upgrading energy technology is evident in the enhanced focus on the Anusandhan National

Research Fund. This financing is intended to support the development of small nuclear reactors and other new technologies, emphasizing the importance of continued investment in research across the energy value chain. Given India's relatively late adoption of new technologies, increased R&D spending is crucial to remaining competitive on a global scale.

Building a Skilled Workforce

Employment creation and skill development are central to the government's clean energy agenda. The emphasis on training for the clean energy sector is crucial for achieving tangible results. Effective allocation of resources for skilling individuals in green technologies will be essential. Collaboration between the government, private sector, and educational institutions will play a key role in fostering a skilled workforce capable of driving the clean energy transition.

Enhancing Climate Finance

The introduction of taxonomy for climate finance is a notable development. By establishing clear criteria for green investments, this framework aims to attract ESG-focused investors and enhance climate finance availability. Additional measures to simplify foreign investment and promote the use of the Indian Rupee in overseas transactions are crucial for creating an investment-friendly environment and supporting the transition to a sustainable energy economy.

> SIMPLIFYING FOREIGN INVESTMENT PROCEDURES AND PROMOTING THE USE OF THE INDIAN RUPEE IN INTERNATIONAL TRANSACTIONS ARE ESSENTIAL STEPS TO FOSTER AN INVESTOR-FRIENDLY ENVIRONMENT AND SUPPORT THE SHIFT TOWARDS A SUSTAINABLE ENERGY ECONOMY

Expanding Renewable Energy and Infrastructure

Substantial resources have been allocated to expanding renewable energy infrastructure, including projects in Ladakh and a commitment to offshore wind energy with an initial target capacity of 1 gigawatt. The focus on developing battery storage capabilities under the Production-Linked Incentive (PLI) scheme and improving EV charging infrastructure further underscores the government's commitment to advancing the renewable energy sector.

Climate-Resilient Agriculture and New Targets

There is also a focus on climate resilience in agriculture, promoting high-yielding, climate-resilient crop varieties and sustainable farming practices. The introduction of a bio-manufacturing scheme supports the development of environmentally friendly alternatives to traditional petroleum-based products. With ambitious climate targets, including achieving net-zero carbon emissions by 2070, these initiatives reflect a robust commitment to environmental sustainability.

As India continues its journey toward energy independence, the successful implementation of all these initiatives will be pivotal in realizing the nation's clean energy ambitions and addressing the challenges of climate change. EPC World

CHANDRA KISHORE THAKUR
CEO - Asia, Africa, LATAM & Europe
Sterling and Wilson Renewable Energy Ltd.

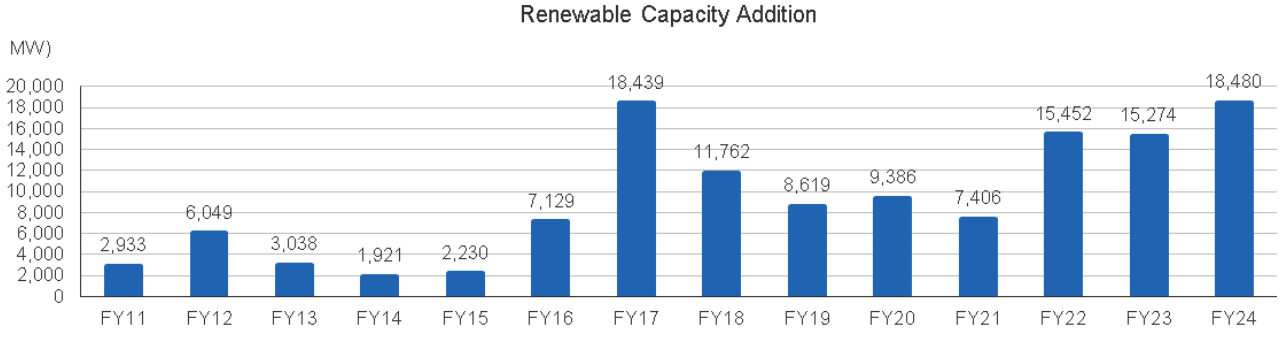
Technology advancements improving the PLF trends in solar generation

The Indian renewable sector growth is underpinned by the increasing power demand, competitive power price, increasing thrust on green energy both domestically and globally, improving project viabilities for generating companies led by reduction in solar module costs, improvement in technologies and improving receivables and a strong future demand from green hydrogen manufacturing. More so, technological advancements are also leading to increased power output which used to be a cause of concern amidst the growing power demand.

In line with the growth targets, the renewable capacity addition has picked up pace post a lull witnessed in FY21. Over FY22-FY24, the addition remained strong at over 15 GWeachand much higher at 18.5GW in FY24and is expected to remain robust over the medium term. Renewable capacity addition is expected remain at around18-20 GW annually, owing to significant reduction in the module prices over the past 12 months and availability of liquidity.

Increased efficiency of solar panels helping in higher generation: the following factors are largely leading to an improvement in the solar output. From average AC side PLFs of around 20% a few years back to around 30% now with these improvements, we believe the increase is significant. The same is expected to continue improving.

- **Use of higher efficiency cells:** There have been significant developments in the PV cells and increasingly deployment of advanced cells, including mono-crystalline, poly-crystalline silicon technologies, is leading to an increase in energy conversion efficiency. Further advancements to technology including P-type PERC and N-type TOPCon technologies is further expected to increase the conversion efficiency. As per studies, under test conditions,



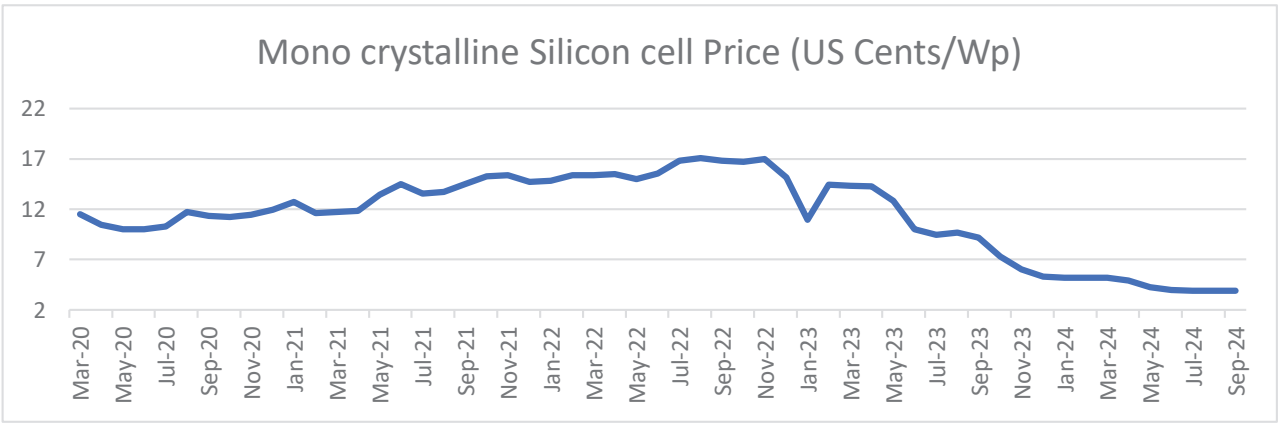
Source: Ind-Ra

the differential between a mono PERC and a TOPCon cell could be close 1%with mono PERC giving a cell efficiency of 23.3% and TOPcon giving an efficiency of 24.4%. Other technologies which are currently in nascent stage include the HJT technology. These newer technologies also have lower degradation thereby lowering the replacement costs.

- **Use of bifacial modules:** Increasingly bifacial modules, which can capture sunlight on both sides is being used leading to higher energy output. These modules are particularly effective in installations where reflected sunlight from the ground can be utilized- areas like the western part of the country. The same can add another 2-3% in efficiency of modules.
- **Use of higher efficiency inverters:** Inverter technology improvements help in reducing the conversion losses from DC to AC which is used in the grid. With improvement in technology, this conversion rate has now moved to over 98.5%, leading to better sizing of the projects and lesser variability in output.
- **Use of axis trackers:** Similarly, trackers are leading to an increased capturing of solar power over a longer duration. These trackers align with the sun's position to capture the maximum input. While single-axis trackers adjust the angle of the solar panels along one axis, dual-axis trackers adjust along two axes. The dual axes trackers can also add 1-2% to the PLFs of the modules.
- **Land availability in resource rich areas:** Over the last couple of years, large scale development is happening in the western region of the country, which has resource potential and irradiance factors. Developments specially in the Kutch region with Khavda renewable park alone having a capacity of 30GW adds to the growth potential of solar power in India.

Apart from the technological improvements, there are the following other improvements in the sector which is paving way for fast paced growth:

Reduction in module prices and development of domestic manufacturing: Module prices have come down substantially over the last 2 years, making the viability of solar projects better and an increase in the returns for the developers as bid out tariffs have remained mostly flat on account of increase in interest rates. Furthermore, increasing domestic production capacities for cells and modules is also creating a stability and eliminating availability risk which is present in imports. The growth in cell and module manufacturing eco system in India is also



boosted by the imposition of 40% basic custom duty on import of modules and 25% basic custom duty on import of cells.As of CYE2023, domestic module manufacturing stood at around 64.5GW and cell capacity stood at 5.8GW. It is estimated to cross 150GW over the next 2-3 years, which should bode well for the sector.

In terms of technology, current module manufacturing capacity is dominated by monocrystalline modules which account for 67.5% of the cumulative production capacity. Polycrystalline modules are at 15.1% market share, followed by 12.3% TOPCon and 5.1% thin-film. Players are increasingly phasing the old technologies with new ones.

Receivables cycle improvement leading to lower working requirement: Debtors across the power sector have declined meaningfully as reflected in the decline in the central public sector companies' receivables beyond 45 days to INR181 billion as of February 2024 from the peak of INR527 billion is September 2022. The decline is a result of the tariff hikes taken by discoms and implementation of the LPS Scheme 2022, which has improved the payment behaviour of discoms leading to a better financial condition for generators. The improvement in the payment behaviour of states with bad financial health would aid in an overall improvement in the sector fundamentals. However, there would be an additional debt burden on discoms on account of availing these schemes, which, if not met with corresponding reforms including regular tariff hikes, continued reduction of AT&C losses and other operational improvements, could again lead to a pile-up in receivables for generating companies and would remain a key monitorable.

Large scale renewable projects requirement for hydrogen production: Hydrogen and specifically green hydrogen is being developed as a fuel for the future to be used for mobility, conversion to Ammonia, Methanol etc. For a widescale pickup in hydrogen production, large scale renewable projects would be needed. It is estimated that around 20GW of renewable energy is needed to produce 1mtpa of Hydrogen. Cost and technological improvements especially on electrolyser systems is underway, which could create a breakthrough, post which renewable capacity addition could further pick up pace.

Way ahead: The demand for power is expected to continue to increase annually by upwards of 7-8% over the next 3-5 years. As a result, for renewable power to provide for this increase, the annual capacity addition becomes imperative along with improvements on the generation, storage capabilities for providing grid stability and round the clock power solutionsand to become a reliable source of power.While we would continue to see around 18-20 GW of annual renewable power capacity addition, for the sector, especially solar, to become a major proportion in generation as well, these ongoing improvements need to continue. EPC World

BHANU PATNI
Associate Director, Sector Head (Energy Vertical)
India Ratings & Research Private Limited (Fitch Group)

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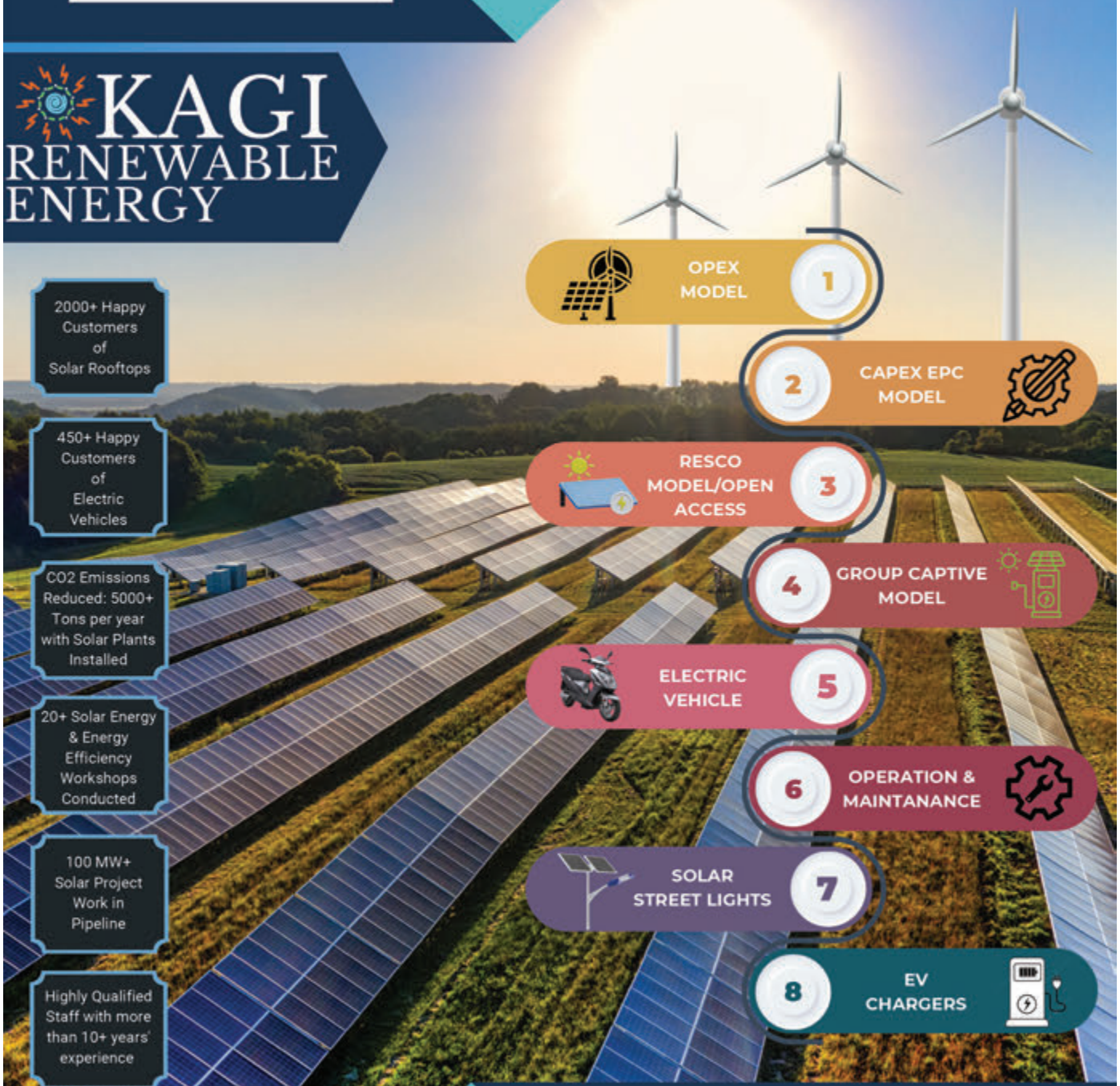

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We are at the forefront of developing new technologies

Our focus is on smart energy management solutions that integrate solar power with battery storage and EV charging, driving a more sustainable future, says **V V KAMATH**, Managing Director, Fronius India, in a conversation with EPC World.

How can we effectively analyze the growth curve of the solar energy sector?

To effectively analyze the growth of the solar energy sector, we must look at both market demand and technological advancements. In India, solar energy is thriving due to government initiatives, increasing environmental awareness, and the need for energy security. At Fronius India, we can see the impact firsthand, with our solar inverters operating in India for over 15 years, delivering reliable solutions. Our Life Cycle Assessments (LCA) enable us to understand the long-term environmental benefits and guide product improvements, ensuring that our solutions align with the sustainable future India envisions.

What strategies are in place to meet the dynamic demands of the renewable energy market?

The renewable energy market is indeed dynamic. Fronius tackles this by offering a comprehensive premium product portfolio, residential inverters - like our Fronius Gen24 Plus & large-scale commercial solutions with Fronius Tauro ECO 50kW & 100kW. Our strategy is focused on sustainability, innovation and local presence. In India, we operate from our Pune HQ, ensuring quick response times, localized support, and reliable solutions tailored to the Indian climate. Our products, including the Fronius Verto and energy storage solutions, are 100% designed and manufactured in Europe, offering superior quality and reliability. Our sustainable products are designed with lowest carbon footprint and last for more than 20+ years providing decades of green electricity.

How can we address the cost concerns while helping customers realize the long-term benefits of solar power reserves?

Cost is a significant factor in any energy solution, but at Fronius, we emphasize long-term value. Our inverters, designed for durability and easy maintenance, offer a strong return on investment. With over 15 years of installations in India still performing efficiently, our customers benefit from reduced energy costs over decades. By focusing on LCAs, we ensure that the environmental benefits far outweigh initial costs, providing our customers with solutions that are not only affordable in the long run but also contribute to a greener planet.

What challenges, such as installation and maintenance, are being faced in the solar energy sector, and how can they be overcome?

While installation and maintenance, skilled workforce with respect to rapid technologies advancement can pose challenges to Solar energy sector, Fronius is here to help. We provide comprehensive training programs for solar industry professionals and offer a reliable service network across India. We tackle installation challenges through local support, and our easy-to-install inverters require minimal tools and workforce. Maintenance is made seamless through tools like the Solar. SOS platform, allowing installers to troubleshoot remotely, thus reducing downtime and ensuring consistent energy production.

What growth strategies are being planned to further advance the solar industry?

Fronius is at the forefront of developing new technologies and business models to propel the solar industry forward. We focus on smart energy management solutions that

integrate solar power with battery storage and electric vehicle charging, paving the way for a more sustainable future.

Which markets in India are showing the highest demand for solar energy solutions?

India's demand for solar energy is growing across various regions, but regions like Maharashtra, Gujarat, and the southern states are leading the charge. At Fronius, we have installed over 15000+ of string inverters across India catering to residential, commercial, and industrial customers. Solar is not a luxury anymore, it is the need of the hour. Both residential as well as C&I sectors are growing rapidly with government incentives, and increased awareness of sustainable energy.

Are you participating in REI Expo 2024? If yes, express your views on the platforms & strategies planned?

We're excited to be part of REI Expo 2024! Please visit us at Hall 14, Booth R1036.

It's a key platform to showcase our latest innovations, including the Fronius Verto, Fronius Tauro and energy storage solutions with Fronius Gen24 Plus models. These products are designed to meet India's unique energy needs while maintaining our 100% Made-in-Europe commitment. Our participation is an opportunity to strengthen partnerships, highlight our sustainable solutions through LCAs, and reinforce our long-standing presence in India. We aim to drive conversations around sustainability, innovation, and the future of solar energy, demonstrating our commitment to empowering India's renewable energy transformation. EPC World

Renewable energy parks are becoming essential pillars for a sustainable future in India

Installations in this industry occur in various environments—parks, rooftops, commercial spaces, water, deserts, or large solar parks—requiring customized switchgear to suit site conditions, says **GANESH KOTHAWADE**, President of ABB India's Distribution Solutions business

Why are Solar Parks essential for building a smarter, more sustainable India?

Electrical Power requirement in India is growing at a very high pace due to urbanization, infrastructure, digitalization, energy transition to meet sustainability goals. Solar parks are best option to meet this increase in power demand more sustainable way. Solar parks harness solar energy, reducing dependency on fossil fuels and mitigating climate change risk. They are essential for building a smarter, more sustainable India for several reasons. With the commitment to achieving 500 GW of renewable energy capacity by 2030, solar parks are a necessary infrastructure as these are large-scale solar projects that act as a powerful catalyst for renewable energy generation. It helps decrease India's carbon footprint aligning with Global efforts to combat global warming and also supports energy self-sufficiency. Such large projects also help build local communities such as creating jobs, promoting skills development, and enhancing livelihood. Renewable energy parks are increasingly becoming foundational for a sustainable future in India, driving renewable energy adoption and leading economic growth.

How critical is Switchgears for the growth of this industry segment?

Switchgear plays a vital role in Solar parks' success as they manage the seamless, safe, and stable flow of electricity. These components together to ensure the efficiency and reliability of power generated in the park. As the renewables scheme has evolved over the years, ABB continues to develop & provide high-rating MV switchgear thus optimizing the equipment used in the overall power chain bringing efficiency in power flow. They also protect equipment from overloads/faults and a smooth integration of power to the grid. With the growing demand for renewable energy, we foresee a huge demand for Switchgear solutions to complement high-performance needs along with safety and reliability. The role of switchgear in this ecosystem cannot be overstated; they are essential for ensuring that solar energy is harnessed effectively, safely, and reliably.

What challenges, such as installation and maintenance, do you face in the solar energy sector, and how can they be overcome?

In this industry, installations take place in diverse environments such as parks, rooftops, commercial space, water, dessert, or large solar parks that need customized Switchgear to meet site conditions. The period of project implementation is generally longer compared to any other industrial segment. Another challenge for all OEMs is to integrate their equipment with various systems of different manufacturers e.g. SCADA/RTUs etc. However, at ABB, we provide complete solutions with standard interfaces (communication protocol, adapters, etc.) enabling lesser installation & commissioning time. Our state-of-the-art design of the switchgear requires minimal maintenance during field life. However, we have a dedicated network of service colleagues and service partners to support our customers throughout the life cycle of the product. Further, Our set of M&D solutions (Condition monitoring solutions viz. CB monitoring, Temperature monitoring, etc.)are designed to provide continuous remote health checkups for switchgear which avoids potential emergencies at the site.

What growth strategies do you have to further advance in the solar industry?

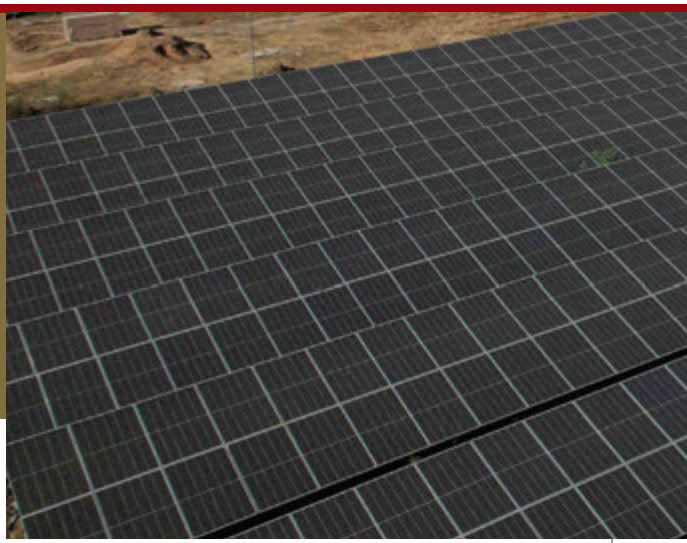
It's exciting to see new segments emerging and backed by a strong fundamental base. Segments like renewable energy are one of the many prominent ones that have a strong growth potential. The government of India's ambition to reach approx. 500 GW of renewable energy capacity is a strong driver of growth in this segment. With increasing demand for reliable electricity supply and a push towards green energy, the switchgear market is poised for significant growth. Digitalization of power systems and the adoption of advanced technologies and sensor-based protection systems will result in further opportunities. The focus on localization has pushed Indian manufacturers to put facilities to manufacture PV cells and modules locally. This has resulted in the growth of switchgear products from the solar value chain. ABB serves the solar market both directly and indirectly as per needs of our customer. Our innovations about Centralized protection & Sensor technology are with a viewpoint of providing solutions with futuristic scenarios. We continue to closely work with our customers on the evolving needs of this industry.

> OUR INNOVATIONS ABOUT CENTRALIZED PROTECTION & SENSOR TECHNOLOGY ARE WITH A VIEWPOINT OF PROVIDING SOLUTIONS WITH FUTURISTIC SCENARIOS

Which are the other upcoming market segments with high demand for Switchgear products?

Several upcoming segment domains are going to witness significant investment starting from Renewables, Datacenters, Semiconductors, Green Hydrogen, E-mobility, etc. In addition, investment in infrastructure will surely push for growth in Metals, Mining & Cement. All the above segments are witnessing double-digit growth. We are continuously investing in increasing our manufacturing capacities to meet this demand growth. EPC World

Untangling the grid: Overcoming transmission bottlenecks and policy challenges



CareEdge identifies several key challenges that need to be addressed to scale up the renewable energy sector. These include execution challenges such as land acquisition issues, rights of way, and transmission bottlenecks. Additionally, the sector faces significant risks due to the weak financial health of distribution companies (discoms), which exposes renewable energy companies to counterparty credit risks. There are also risks associated with changes in law, tariffs, and duties on components, which can affect the financial viability of renewable energy projects.

Furthermore, commercial and industrial (C&I) players are vulnerable to adverse changes in wheeling charges, cross-subsidy surcharges, and additional surcharges, all of which can undermine project viability. The rooftop solar segment has seen slow growth, largely due to inconsistent support from state authorities. Moreover, the sector's intermittent nature makes it dependent on adequate energy storage capacities, which are currently insufficient. Lastly, the limited availability of domestic capacity for key components used in solar panels, wind turbines, and batteries poses a risk, as it increases dependence on imports, which can be affected by geopolitical factors.

Therefore, it is crucial that the policy and regulatory frameworks put in place address these risks, enabling the sector to scale up and achieve the 500 GW target.

Policy framework to sort out execution challenges in the RE sector: What has emerged as a key bottleneck for the growth of the capacity is the transmission bottleneck in key solar and wind resource rich regions such as Rajasthan and Gujarat. These have arisen out of factors like unavailability of land for substations and rights of way and the Great Indian Bustard issue. In other states too, availability of land for RE plants, particularly in the case of wind energy projects, which are dispersed and very microsite specific remains a challenge. In addition, availability of transmission networks at state level and right of way connecting plants to state transcos also remains an area of concern. The central govt needs to work closely with the Central Transmission Utility and the state government to sort out these issues. State governments need to put in place policies which smoothen out land acquisition and transmission linkages. The government also needs to continue with exemption from transmission charges for RE players.

Expediting distribution sector reforms: The Central government has already put in place the LPS mechanism which has resulted in timely payments for over a year now. The Government has put in place additional measures to improve financial health of Discoms with streamlining the process of accounting, reporting, billing and payment of subsidy by States to the Distribution Companies. These measures need to be persisted with. With discoms in several states still remaining loss making, state governments need to expedite reform measures including roll out of loss reduction measures including smart meters. In addition, the tariff setting process needs to be depoliticised and adequate funding should be provided to government departments and local bodies, which are currently in delay of payments to discoms.

Strengthening of the regulatory process especially at the state level: The tariffs of RE projects are by and large determined by bid based tariffs. However, there can be changes arising due to factors which are beyond the control of developers. These factors include change in law conditions (such as change in taxes, duties, etc) or delayed project commencement due to delays on part of CTUs/STUs in providing transmission connections. While these are generally pass through, it often takes a long while for ERCs to adjudicate on the same and for the same then to be recovered through billing process. A policy framework needs to be put in place for ensuring that such processes are completed in a time bound manner.

Rationalising of charges, open access policies at state levels: While the C&I segment has shown a healthy growth driven partly by improving cost economics and also the increasing regulatory/investor requirement to green the corporate processes, the growth of the market is restricted by restrictions being placed by various state regulators, partly with a view to protecting the interests of the state discoms, which risk loss of high paying customers. As a result, there have been tightening of norms on banking facilities as well as imposition of additional surcharges which make supply from RE C&I players uncompetitive. Viewed against this backdrop, a harmonisation of the norms with respect to banking, availability of transmission open access and cross subsidy/additional surcharges across various states so as to balance the interests of both RE players and discoms will be very critical.

An issue which is impacting the development of rooftop solar, including those by C&I customers is the inconsistent net metering policies across states and their varied implementation. Net metering is critical for the financial viability of a rooftop solar plant. To protect their economic interests, DISCOMs sometimes delay the net metering approval or fail to provide approval altogether, especially to C&I customers. Policy framework should be put in place which ensures timely net metering implementation.

Another related issue is related to implementation of Green Energy Open Access. Many states have sought to delay the implementation of GEOA. Where GEOA is allowed, state regulations don't allow a consumer to avail both GEOA and rooftop solar simultaneously. This issue needs to be sorted out too.

Expediting build-up of energy storage capacities: With robust demand growth and limited possibility of thermal addition in the next three years, likelihood of supply shortage in the non solar hours cannot be ruled out. Therefore, the government needs to promote both battery and pumped storage. For battery storage, increasing VGF so that storage becomes cost competitive till the intrinsic cost of battery usage comes down will be critical. The state governments need to smoothen about clearances required for expediting pumped storage (especially w.r.t land, water). In addition to pumped storage, policy framework needs to be strengthened for development of conventional hydro power projects as well. Given that most new hydro power projects will necessarily have to be built in more challenging terrain in Arunachal Pradesh and remote locations in J&K, HP and Uttaranchal, the central and state governments will have to put in place mechanisms so that the cost of infrastructure development (which is a substantial part of the total project cost) is borne by the exchequer so that the new hydro projects can be more economical. Govt should also gradually increase hydro power obligation (HPO) to encourage offtake from the new hydro power plants. Tariff norms for such plants can also be tweaked (for instance a longer period for recovery of debt servicing cost by way of depreciation) to make tariffs more affordable.

Development of domestic manufacturing ecosystem for wind, solar and battery storage: The government needs to develop the domestic manufacturing ecosystem for wind, solar and battery storage through policy measures such as speedy approvals, provision for land close to port locations on a cluster basis. In addition, the government can continue with PLI incentives for domestic manufacturers. EPC World

SABYASACHI MAJUMDAR
Senior Director
CareEdge Ratings

A robust policy framework is needed to support energy storage solutions

We plan to introduce new high-efficiency solar modules and energy storage solutions, says **ANKIT SINGHANIA**, Director - Sales & Procurement, Navitas Solar

Your take on expanding scope & growth potentials for renewable energy in India

India's renewable energy sector is poised for significant growth, driven by the country's ambitious targets and supportive policies. The government aims to achieve 500 GW of renewable energy capacity by 2030, with solar power playing a crucial role. The increasing demand for clean energy, coupled with technological advancements and declining costs, presents vast opportunities for expansion. Additionally, India's commitment to reducing carbon emissions and enhancing energy security further underscores the growth potential of renewable energy.

What are some strategies to help reduce land acquisition and transmission infrastructure bottlenecks for large-scale solar projects?

To address land acquisition challenges, adopting innovative approaches such as agrivoltaics, which combines agriculture and solar energy production, can be effective. Utilising barren and non-agricultural lands for solar projects can also minimize conflicts. For transmission infrastructure, developing decentralized solar power systems and microgrids can reduce the need for extensive transmission networks. Additionally, the strategic interconnection of existing microgrids to larger transmission systems can enhance grid reliability and resilience.

How can policies be developed to encourage greater private sector participation and financing in the solar energy space?

Policies to encourage private sector participation should focus on creating a conducive investment environment. This includes offering tax incentives, subsidies, and streamlined regulatory processes. Enhancing the availability of concessional finance and green bonds can mitigate risks and attract private investors. Establishing public-private partnerships and providing guarantees for long-term power purchase agreements (PPAs) can also boost confidence among private players.

With storage emerging as a key enabler for solar, what incentives are needed to boost investment in battery technologies and other energy storage solutions?

To promote investment in battery technologies, the government can offer production-linked incentives (PLI) and tax

credits for manufacturers. Funding research and development initiatives to advance battery technology and reduce costs is crucial. Additionally, implementing policies that support the integration of energy storage with renewable energy projects, such as subsidies for storage systems paired with solar installations, can drive investment.

What can states/central governments do to accelerate India's transition to high-efficiency panel technologies?

States and central governments can accelerate the transition to high-efficiency panel technologies by providing financial incentives for adopting advanced technologies. This includes subsidies, tax breaks, and grants for research and development. Implementing policies that mandate the use of high-efficiency panels in government-backed projects can also drive adoption. Furthermore, fostering collaborations between research institutions and industry players can facilitate technological advancements.

What should India's roadmap look like for developing a self-reliant solar manufacturing value chain over the next 5-10 years?

India's roadmap for a self-reliant solar manufacturing value chain should focus on establishing a vertically integrated ecosystem. This involves developing domestic capacities for producing polysilicon, wafers, cells, and modules. The government can support this through the PLI scheme, which incentivizes local manufacturing. Additionally, investing in research and development to innovate and improve manufacturing processes is essential. Creating ancillary markets for recycling and reusing solar components can further enhance sustainability.

How can India accelerate the adoption of newer and more efficient panel technologies?

To accelerate the adoption of advanced panel technologies, India can implement supportive policies that offer incentives like subsidies, tax breaks, and regulatory backing for their deployment. Investing in research and development to improve the efficiency and affordability of these panels is crucial. Additionally, promoting awareness and education about the benefits of high-efficiency panels can drive market demand.

What role should financial institutions and corporates play in scaling up solar projects?

Financial institutions and corporates play a critical role in scaling up solar projects by providing the necessary capital and expertise. They can offer financing solutions such as green bonds, sustainability-linked loans, and project aggregation platforms. Corporates can also invest in solar projects as part of their sustainability initiatives, leveraging their resources and influence to drive large-scale adoption. Collaborating with governments and other stakeholders to de-risk investments and create bankable projects is essential.

What are the opportunities and roadmap to strengthen India's domestic solar manufacturing base?

Strengthening India's domestic solar manufacturing base requires a multi-faceted approach. This includes enhancing manufacturing capacities for upstream photovoltaic value chain products, such as polysilicon and wafers. The government can support this through the PLI scheme and other incentives. Investing in research and development to innovate and improve manufacturing processes is crucial. Additionally, creating a favorable policy environment that encourages private sector participation and foreign investments can drive growth.

The key uniqueness of your products & expertise that gives you an upper hand in the market space

Navitas Solar stands out in the market with its commitment to quality and innovation. Our solar modules are designed with high efficiency and durability, ensuring optimal performance even in challenging conditions. We leverage advanced manufacturing technologies and stringent quality control processes to deliver reliable and cost-effective solar solutions. Our expertise in the solar industry, combined with a customer-centric approach, gives us a competitive edge in the market.

Navitas Solar offers a diverse range of solar products tailored to meet various energy needs. Our modules are designed to deliver maximum power output with high efficiency, ensuring optimal performance even in low-light conditions. The bifacial solar panels capture sunlight from both sides, increasing energy generation and overall efficiency. The flexible solar panels are ideal for unconventional surfaces. Our flexible panels are lightweight and adaptable, making them perfect for a variety of applications. Our solar inverters are engineered for reliability and efficiency, converting solar energy into usable electricity with minimal loss. We offer advanced battery storage systems that ensure a stable and reliable power supply, even during grid outages.

Are you participating in REI Expo 2024? If yes, express your views on the platforms & strategies/product innovations planned?

We are excited to participate in the REI Expo 2024 at Stall No. R476, Hall No. 9-12. This platform provides an excellent opportunity to showcase our latest product innovations and strategies. We plan to introduce new high-efficiency solar modules and energy storage solutions that cater to the evolving needs of the market. Our focus will be on demonstrating the benefits of our products in terms of performance, reliability, and cost-effectiveness. We look forward to engaging with industry stakeholders and exploring potential collaborations to drive the growth of renewable energy in India. EPC World

Energy storage is crucial for the widespread adoption of solar power

Coordinated efforts between financial institutions, corporations, and government bodies are crucial to meet RE target says **HANISH GUPTA**, Founder & CEO, Sunkind Energy

Your take on expanding scope & growth potentials for renewable energy in India

We believe India's renewable energy sector, particularly solar, holds immense potential for growth. The country's installed solar capacity has seen a remarkable 30-fold increase over the past nine years, reaching 87.2 GW as of July 2024. This growth, coupled with India's position as the world's fifth-largest solar power producer, demonstrates our nation's commitment to clean energy. However, to achieve the ambitious target of 500 GW of renewable energy by 2030, we need to address several challenges. These include streamlining land acquisition processes, enhancing transmission infrastructure, developing robust storage solutions, and localizing supply chains. We're focused on driving innovation in solar technologies and promoting both utility-scale and distributed renewable energy projects. We believe that by adopting newer, more efficient panel technologies, encouraging rooftop solar adoption, and strengthening domestic manufacturing, India can accelerate its journey towards its renewable energy goals and net-zero emissions target by 2070.

What are some strategies to help reduce land acquisition and transmission infrastructure bottlenecks for large-scale solar projects?

We recognize that land acquisition and transmission infrastructure bottlenecks are significant challenges for large-scale solar projects in India. To address these issues, we propose a multi-faceted approach. Firstly, we advocate for the development of solar parks on government-owned land, which can significantly reduce acquisition hurdles. Secondly, we support the implementation of a single-window clearance system to streamline the land acquisition process. This apart, we encourage utility companies to plan for a single approval process and consolidated charges for transmission infrastructure under a single-stage approval system. This will simplify procedures and minimize delays. Furthermore, we encourage the government to provide transmission infrastructure solutions such as Line In - Line Out (LILO) facilities to ensure seamless integration of solar projects into the grid. To tackle transmission bottlenecks, we recommend investing in grid modernization and expansion, particularly in regions with high

solar potential. Additionally, we propose the development of decentralized mini-grids to reduce dependency on long-distance transmission. We're also focusing on innovative solutions like floating solar projects on reservoirs and canals, which minimize land use. We're actively collaborating with state governments to identify and utilize barren lands for solar installations. Lastly, we believe that enhancing public-private partnerships and improving coordination between central and state agencies can expedite both land acquisition and infrastructure development, crucial for achieving India's ambitious renewable energy targets under Prime Minister's vision & leadership.

How can policies be developed to encourage greater private sector participation and financing in the solar energy space?

We believe that encouraging greater private sector participation and financing in the solar energy space requires a multi-pronged policy approach. The government should consider expanding low-interest loan programs and enhancing tax incentives for solar investments. This could include accelerated depreciation benefits and production-linked incentives for manufacturers. Implementing a robust and predictable regulatory framework is crucial. This should include streamlined permitting processes and clear, long-term renewable purchase obligations for utilities. Policies supporting innovative financing mechanisms like green bonds and solar-specific investment trusts can unlock new capital sources. Furthermore, increasing R&D funding for solar technologies can drive innovation and reduce costs, making solar more attractive to investors. Mandating solar installations on public buildings and infrastructure can create a steady demand, boosting investor confidence.

With storage emerging as a key enabler for solar, what incentives are needed to boost investment in battery technologies and other energy storage solutions?

Energy storage is crucial for the widespread adoption of solar power. To boost investment in this sector, we believe a comprehensive incentive framework is essential. Introducing tax credits specifically for energy storage installations, both standalone and coupled with solar systems, can significantly reduce upfront costs. Rebates and grants, tailored for residential and commercial projects, can further stimulate market growth. Implementing a production-linked incentive scheme for domestic battery manufacturing can boost local production and reduce costs over time. Additionally, regulatory policies that allow storage assets to participate in ancillary services markets can create new revenue streams, enhancing project viability. We are of the view that by implementing these incentives and leveraging technological advancements, we can accelerate the adoption of solar energy storage, enhancing energy security and driving us towards a sustainable future.

How can India accelerate the adoption of newer and more efficient panel technologies?

Accelerating the adoption of newer, more efficient panel technologies is essential to achieving India's energy independence goal by 2047. We are committed to driving this transition by continuously innovating to deliver the most efficient solar solutions for both utility-scale and distributed projects across India. To achieve this, a multi-pronged approach is needed: increasing funding for

> ACCELERATING THE ADOPTION OF NEWER, MORE EFFICIENT PANEL TECHNOLOGIES IS ESSENTIAL TO ACHIEVING INDIA'S ENERGY INDEPENDENCE GOAL BY 2047

research into cutting-edge technologies, revising regulations to prioritize high-efficiency panels in government tenders, and launching workforce training programs to handle advanced technologies. In particular, TOPCon (Tunnel Oxide Passivated Contact) technology is gaining traction due to its higher efficiency and lower degradation rates compared to traditional PERC (Passivated Emitter and Rear Cell) technology. TOPCon is expected to dominate the market in the next 2-3 years, setting new industry benchmarks. However, HJT (Heterojunction Technology) offers even greater efficiency potential, with its thinner wafers and promise of long-term performance. Although HJT currently faces challenges with higher production costs, advancements in manufacturing could make it a key future technology. In addition to supporting technological shifts, campaigns to educate consumers on the benefits of high-efficiency panels, along with tax breaks or subsidies for projects utilizing advanced panel technologies, will further accelerate the adoption of these innovations.

What policy push is needed for batteryenergy storage to complement rising solar capacities?

To complement the rising solar capacities in India, a strong policy push for Battery Energy Storage Systems (BESS) is essential, particularly for small and medium-sized enterprises (SMEs). Tailored BESS solutions must be developed to cater to SMEs, offering modular, scalable options that address their specific energy needs. Financial incentives such as subsidies, tax breaks, and concessional loans will encourage wider adoption, while expanding the Production Linked Incentive (PLI) scheme to cover smaller energy storage systems can drive investment. Capital subsidies and low-interest loans will reduce the high upfront costs of BESS, making it financially viable for SMEs. Innovative models like "pay-as-you-go" can offer flexibility, allowing smaller businesses to scale up as needed without the financial burden. Policy reforms should also broaden the scope of BESS to include decentralized and smaller applications, with mandates for industries to adopt energy storage systems for enhanced reliability. Moreover, localized manufacturing and supply chain development must be incentivized through an expanded PLI scheme, encouraging domestic production and reducing costs. Investment in research and innovation for affordable, efficient storage solutions will further accelerate adoption. These measures will enable SMEs to benefit from clean energy and support India's renewable energy transition.

What role should financial institutions and corporates play in scaling up solar projects?

Financial institutions and corporations play a pivotal role in scaling up solar projects in India, especially in light of the 2024-25 Budget's substantial allocation to solar power grid projects. To bridge the funding gap in the renewable energy sector, financial institutions should offer innovative financing solutions like green bonds, low-interest loans, and blended finance models. These mechanisms can accelerate the deployment of solar projects and attract more private investment. Corporations, on the other hand, can drive solar adoption by investing directly in renewable energy, forming public-private partnerships, and securing long-term Power Purchase Agreements (PPAs). They can integrate solar energy into their operations, support research and development for advanced technologies, and enhance grid integration. Corporates can also issue green bonds, manage project risks, and promote sustainability through Corporate Social Responsibility (CSR) initiatives. Notably, their influence on government policies, industry standards, and supply chains can further accelerate solar demand. Achieving India's ambitious target of 500 GW of renewable energy by 2030 will require an estimated investment of INR 30 lakh crore. I am of the firm view that coordinated efforts between financial institutions, corporations, and government bodies are crucial to meet this target within the expected timelines and create a sustainable clean energy ecosystem.

What are the opportunities and roadmap to strengthen India's domestic solar manufacturing base?

India's domestic solar manufacturing base presents a significant opportunity, particularly given the growing demand across sectors like agriculture, commercial, and residential. The government's proactive policies, such as the PLI scheme and import tariff protections, have laid a strong foundation for expanding domestic manufacturing. By 2028, the expected rise in module and cell manufacturing capacity to 150 GW and 100 GW, respectively, along with a robust supply chain of 400 GW, underscores India's potential to become a global solar manufacturing hub. To fully capitalize on these opportunities, it is essential to address existing challenges, such as supply chain localization, technological innovation, and financing. Glad to say that Sunkind is positioning itself as a key player in India's renewable energy sector with a clear focus on expanding solar manufacturing capabilities. The company's 1.5 GW PV module production unit, set to be operational by April 2025, and the DCR solar cell production slated for 2028, will significantly strengthen India's supply chain. This will help reduce import dependency and boost the nation's renewable energy footprint over the next five years.

The key uniqueness of your products & expertise that gives you an upper hand in the market space

Our strength lies in our steadfast commitment to quality and a customer-centric approach. We prioritize building strong, lasting relationships with our clients by providing responsive service tailored to their specific needs. Our in-house expertise ensures that every project is executed by our certified teams, allowing us to maintain complete control over quality and timelines. Our strong design and procurement teams create customized solutions that meet client requirements effectively. Additionally, our focus on compliance and safety ensures that all our projects adhere to the highest regulatory standards. Through vertical integration, we support the 'Make in India' initiative by locally manufacturing key components, enhancing our ability to deliver projects on time while maintaining both quality and cost efficiency. EPC World

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We have reduced import dependence

First and foremost, we must invest in customer education to demystify the economics of solar energy, says **PRASHANT MATHUR**, CEO, Saatvik Solar

How can we effectively analyse the growth curve of the solar energy sector?

India's solar energy sector has witnessed remarkable growth, positioning the country as a global leader with 81.81 GW of installed capacity, which now accounts for 63.4% of its renewable energy generation. This rapid expansion is driven by several critical factors that will shape the future of India's energy landscape. First, the continuous reduction in the cost of solar energy has been instrumental. As technological advancements drive efficiencies and manufacturing scales up, India's levelized cost of energy (LCOE) is now among the lowest in the world. This cost competitiveness enhances India's attractiveness as a key player in the global renewable energy market. Government support has played an indispensable role in accelerating this growth. Initiatives like the National Solar Mission and the Production Linked Incentive (PLI) scheme have spurred domestic manufacturing and installations. The Pradhan Mantri Suryodaya Yojana, which aims to install rooftop solar systems for millions of households, has further extended solar adoption to grassroots levels. India's geographical advantage, with abundant sunlight, coupled with global partnerships such as the International Solar Alliance (ISA), strengthens its leadership in the global solar revolution. As we work towards achieving the 500 GW renewable energy target by 2030, innovation and quality remain paramount at Saatvik Solar to ensure we remain at the forefront of this transformation.

What strategies are in place to meet the dynamic demands of the renewable energy market?

As a key player in India's solar industry, it is safe to say that our sector is employing multifaceted strategies to meet the dynamic demands of the renewable energy market.We're rapidly scaling up manufacturing capabilities, bolstered by government production-linked incentive schemes that have attracted significant industry interest. A crucial focus is developing a robust, domestic end-to-end supply chain. We've reduced import dependence from 70% to 30% in recent years, supported by government initiatives & this drive towards self-reliance is strengthening our industry's foundation. Innovation is another cornerstone of the strategy to meet the dynamic demands of the industry. Increased R&D investment, particularly in energy storage and green hydrogen, is a step

towards progress. Government tenders and viability gap funding schemes are accelerating progress and enabling competitive price discoveries in these areas. Many solar companies in the country are also expanding to global footprint, positioning India as a major player in the international renewable energy market. This not only opens new markets but brings valuable expertise and investment. Collectively we need to work towards our goal to significantly contribute to India's ambitious renewable energy targets while establishing ourselves as global leaders. At Saatvik Solar, we're aligned with these trends, focusing on innovation in product development and production processes. By investing in cutting-edge technology and R&D, we're enhancing our solar PV modules' efficiency and performance, ensuring competitiveness in this fast-evolving market.

How can we address the cost concerns while helping customers realize the long-term benefits of solar power reserves?

Addressing cost concerns while promoting the long-term benefits of solar power requires a strategic focus on education, financing solutions, and value demonstration. First and foremost, we must invest in customer education to demystify the economics of solar energy. Many potential customers remain unaware of the substantial savings achievable through solar installations over time. By providing clear, accessible information about payback periods, return on investment, and long-term cost savings, we can empower consumers to make informed decisions. Innovative financing models are crucial. The sector should collaborate with financial institutions to offer accessible options like low-interest loans, leasing arrangements, and power purchase agreements. These strategies can significantly lower entry barriers, making solar more attainable for a broader customer base. Furthermore, emphasising energy independence and price stability can resonate with cost-conscious consumers. As traditional energy prices fluctuate, solar offers predictable, long-term savings. Lastly, the industry should advocate for supportive policies and incentives. By working with governments to maintain and expand tax credits, rebates, and grid integration policies, we can further enhance the economic appeal of solar power reserves.

What challenges, such as installation and maintenance, are being faced in the solar energy sector, and how can they be overcome?

The Indian solar sector stands at a pivotal juncture, facing challenges that are equally matched by unprecedented opportunities. Our journey from 2.6 GW to 89.4 GW of installed capacity in just nine years showcases the industry's resilience and potential. Policy volatility and financing hurdles have tested the sector, yet they've also catalyzed innovation. Collaborative efforts between government and financial institutions are yielding new funding models, democratizing solar access across India. The skills gap, especially in rural areas, presents a dual challenge and opportunity. Investing in comprehensive training programs is not only addressing this shortage but also driving rural employment and economic growth. Further, grid integration in diverse geographical conditions pushes technological boundaries. The sector is developing cutting-edge smart grid technologies and robust infrastructure solutions, setting new global benchmarks. Environmental concerns are spurring eco-friendly installation methods, and balancing energy needs with conservation. Innovations in decentralized rooftop solutions and underground transmission are reshaping our approach to large-scale installations. As India advances towards its ambitious 500 GW non-fossil fuel target by 2030, the solar industry stands ready to lead. These challenges are not roadblocks but stepping stones, propelling us towards a cleaner, more sustainable energy future. The solar revolution is not just imminent; it's unfolding now, transforming India's energy landscape.

What growth strategies are being planned to further advance the solar industry?

The Indian government's 2024-2025 energy budget outlines ambitious growth

strategies to advance the solar industry, reflecting a strong commitment to sustainable energy. At the forefront is a significant increase in funding, with the budget for grid-connected solar projects nearly doubling to $1.1 billion and a 78% boost for the PM-KUSUM scheme promoting solar in agriculture. These financial injections aim to accelerate both utility-scale and rooftop solar installations, crucial for achieving the target of 500 GW from non-fossil sources by 2030.

A key focus is enhancing domestic solar module manufacturing to reduce import dependency. The government has allocated over $3 billion through the production-linked incentive scheme, aiming to expand India's solar PV module manufacturing capacity from 38 GW in 2023 to an impressive 116 GW by 2026. This move not only boosts self-reliance but also positions India as a potential global leader in solar technology.

Furthermore, the government is fostering public-private partnerships to develop small modular reactors and enhance nuclear technology R&D, complementing solar initiatives. These collaborative efforts are essential for meeting future energy demands while effectively integrating various clean energy sources. Through these comprehensive strategies, India aims to significantly advance its solar sector, enhancing capacity, efficiency, and sustainability while contributing to its broader clean energy goals.

Which markets are showing the highest demand for solar energy solutions?

In recent years, the Indian solar energy market has shown remarkable growth, reflecting a significant shift towards sustainable energy solutions. Among the states leading this transformation are Rajasthan, Gujarat, Karnataka, and Tamil Nadu, each showcasing significant installed capacities and ambitious growth plans. Rajasthan, with an impressive installed capacity of 21.47 GW, is at the forefront, driven by robust policies that incentivise solar power generation. The state's commitment to expanding solar infrastructure and implementing projects for household electrification further amplifies the demand for solar solutions. Furthermore, Gujarat, boasting 13.80 GW of solar capacity, also demonstrates high demand, attracting a diverse range of investments. The state's focus on small-scale distributed solar projects and continuous policy updates ensures a robust market for solar energy solutions. Karnataka and Tamil Nadu, with installed capacities of 8.72 GW and 8.33 GW respectively, are emerging markets where ongoing investments and financial incentives are enhancing solar adoption. These states' proactive policies, economic strength, streamlined regulatory processes, and improvements in grid infrastructure are pivotal in fostering a strong market for solar energy solutions. With India's ambitious target of reaching 500 GW of renewable energy by 2030, the demand for solar solutions is expected to escalate significantly.

Are you participating in REI Expo 2024? If yes, express your views on the platforms & strategies/product innovations/ product launch planned?

Yes, we will be participating at the event. This platform provides an excellent opportunity for us to showcase our innovations and engage with key stakeholders in the renewable energy sector. At the expo, we plan to highlight several strategic product innovations, including our advanced solar PV modules, particularly our half-cut modules, which are designed for enhanced performance. We will also present our upcoming cell manufacturing capabilities, set to launch shortly, along with customized solutions tailored to meet diverse customer needs. Moreover, we aim to share insights about our initiatives in energy storage and our explorations into electrolyzer technology for green hydrogen projects. Our focus on sustainability and quality assurance will also be emphasized, demonstrating how we maintain high standards while ensuring ethical practices in our operations. EPC World

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Solar parks are crucial for creating a sustainable energy future

Addressing cost concerns while demonstrating the long-term benefits of solar power requires innovative financing solutions and consumer education, says **JIGAR G RAJ**, Renewable Energy Expert, Kagi Renewable Energy

How can we effectively analyze the growth curve of the solar energy sector in India?

The growth of the solar energy sector in India can be assessed through a combination of installed capacity, government policies, and technological advancements. As of 2024, India boasts an installed capacity of approximately 70 GW, with an ambitious target to reach 280 GW by 2030. Projects like the 30 GW Hybrid Renewable Energy Park at Khavda in Gujarat are excellent examples of the rapid expansion and capacity building currently underway. Furthermore, government initiatives such as the PM Suryaghar Yojana and PM-KUSUM play a crucial role in decentralizing solar energy and facilitating rural access to solar power. International partnerships, like the India-US Climate and Clean Energy Agenda 2030, also contribute significantly to this growth. Investment trends show a rising interest in solar, particularly with innovative funding mechanisms like green bonds. To truly understand the growth curve, it's essential to analyze these aspects together, considering both short-term gains and long-term sustainability goals.

What strategies are in place to meet the dynamic demands of the renewable energy market?

To meet the growing renewable energy demand, a multi-faceted approach is essential. Key strategies include robust policy and regulatory initiatives such as the Renewable Purchase Obligation (RPO) and Viability Gap Funding (VGF), which provide a strong framework for sustained growth. Additionally, hybrid renewable energy projects are vital, with the 30 GW Hybrid Renewable Energy Park at Khavda serving as a prime example of integrating solar, wind, and battery storage systems to ensure a stable energy supply. Decentralisation is also a critical focus, as the PM Suryaghar Yojana aims for rooftop solar installations, targeting 40 GW of rooftop capacity by 2025. This approach not only meets residential and industrial energy needs dynamically but also positions India as a leader in renewable energy.

How can we address cost concerns while helping customers realize the long-term benefits of solar power?

Addressing cost concerns while demonstrating the long-term benefits of solar power requires innovative financing solutions

and consumer education. Innovative financing models such as green loans and pay-as-you-go (PAYG) systems make solar energy more accessible to a broader audience. Programs like the PM Suryaghar Yojana offer subsidies that significantly reduce upfront costs for rural and residential users, making the transition to solar more feasible. Additionally, it is essential to educate customers on the long-term savings that solar energy can provide. Although the initial investment may seem high, solar energy often has a lower Levelized Cost of Energy (LCOE) compared to fossil fuels, leading to significant savings over time. By focusing on educating customers about these long-term financial and environmental benefits while ensuring access to affordable financing options, we can address cost concerns effectively.

Why are solar parks essential for building a smarter, more sustainable India?

Solar parks are crucial for creating a sustainable energy future for several reasons. First, they offer land efficiency, as demonstrated by the Khavda Hybrid Renewable Energy Park, which maximizes energy production in regions with high solar irradiance. By optimizing land use, these parks can generate substantial energy from smaller areas. Second, centralized energy production through solar parks ensures grid stability, particularly when combined with battery energy storage systems (BESS), which help manage the intermittency of solar energy. Furthermore, solar parks are significant economic drivers, creating jobs across installation, maintenance, and manufacturing sectors, contributing to regional economic growth. These parks also attract foreign investment, particularly through public-private partnerships and international collaborations, which is essential for meeting our renewable energy targets.

What challenges are being faced in the solar energy sector, and how can they be overcome?

The solar energy sector faces several challenges, but innovative solutions can address these issues. One significant challenge is land acquisition, particularly in densely populated areas. To overcome this, solutions like floating solar technology or utilizing barren lands for solar parks, such as Khavda, can be practical alternatives. Another challenge is grid integration, as solar power is inherently intermittent. Modernizing the grid and investing in energy storage solutions are critical steps to ensure steady energy availability. Additionally, maintenance can be a hurdle, especially in harsh environments. Innovations like robotic cleaning systems are emerging to reduce maintenance costs and improve panel efficiency. Through a combination of technology, policy support, and international partnerships, we can successfully navigate these challenges and enhance the role of solar energy in India.

What growth strategies are planned to advance the solar industry further?

India is implementing several strategies to further advance the solar sector. A key component of this is boosting domestic manufacturing through initiatives like the Production-Linked Incentive (PLI) scheme, which encourages local production of high-efficiency solar modules, thereby reducing import dependency and fostering innovation. Additionally, hybrid projects, exemplified by the 30 GW Khavda Hybrid Park, are pivotal in ensuring a steady energy supply while optimizing resource use. Furthermore, international collaboration plays a significant role, as partnerships with countries like the United States, Germany, and Japan help bring advanced technologies and attract foreign direct investment to the renewable energy sector. Together, these strategies will enable India to meet its ambitious renewable energy goals while promoting innovation and economic growth.

Which markets are showing the highest demand for solar energy solutions?

The demand for solar energy solutions is particularly strong in several markets. The commercial and industrial sectors lead the way, driven by their need for sustainable, cost-effective energy solutions that align with environmental, social, and governance (ESG) goals. Additionally, the agriculture and residential sectors are witnessing rapid growth in decentralized solar energy solutions, especially under programs like the PM Suryaghar Muft Bijli Yojana and PM-KUSUM, which promote rooftop installations and solar pumps. Furthermore, large-scale public sector projects, such as the Khavda Hybrid Park, indicate significant government interest in renewable energy adoption across various states. These trends suggest a robust market demand for solar energy solutions in India.

Are you participating in REI Expo 2024? What are your views on the platforms and product innovations being launched?

Yes, we are excited to participate in REI Expo 2024. This event provides an exceptional opportunity to showcase the latest innovations in solar technology, including high-efficiency solar modules, floating solar systems, and advanced battery storage solutions. At the Expo, we plan to focus on integrating BESS with solar installations, which is essential for stabilizing grid supply and enhancing energy reliability. Moreover, the Expo fosters meaningful dialogues among industry leaders, policymakers, and international partners, allowing us to collaborate and shape India's renewable energy future. This platform is invaluable for driving innovation and expanding our network within the industry.

Grid connected segment will witness significant growth

I see increasing penetration of intermittent and infirm renewables is leading to a move towards every grid ecosystem moving towards digital, cloud, IoT and AI technologies, says **UDIT GARG**, CEO & Director, Kundan Green Energy

How can we effectively analyze the growth curve of the solar energy sector?

India's need for energy per se and green, sustainable energy particularly, is expected to increase more than any other country in the immediate and the medium term. Our sheer size and enormous potential for growth and development necessitate this. Naturally, most of this demand must be addressed through low carbon renewable resources, especially in light of our commitment to a net zero emission target by 2070 which includes 50% of electricity needs from renewable resources by 2030. As of December 2023, solar power accounted for 16.9% of the total installed power capacity and 40.1% of total installed renewable capacity. The country's solar power market is estimated to grow at a CAGR of 52.07% till 2028. This is led by rising investments on renewable energy, supportive Government policies, and the increased adoption of microgrids. The Government has implemented various schemes under the National Solar Mission including incentivizing grid connected solar PV projects with Viability Gap Funding (VGF). The solar home systems ---- Surya Ghar is another key vector at the consumer level.

I see the grid connected segment witnessing significant growth. Its main feature is that it supplies solar energy directly to the building loads without the need for any energy storage systems. Moreover, the segment is designed in such a way that the surplus energy is fed back to the grid with a provision to import it from the grid in case of shortfalls. Grid connected solar energy will dominate. A key factor I would like to mention here is the trends in adoption of floating solar power plants. This will rise. The main advantage of a floating plant is that it can be installed in human-made or natural water bodies such as dam reservoirs, lakes, municipality water storage ponds, and water treatment plants. Additionally, the performance of floating systems is better than the arrays that are built on the land. Moreover, these floating power plants are cooler than traditional systems due to evaporating water which allows them to operate more efficiently. Some of the other advantages of floating power plants include longer module life and higher efficiency of solar panels due to the cooling effect. Hence, such factors are positively impacting the market which in turn will drive growth during the forecast period.

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What strategies are in place to meet the dynamic demands of the renewable energy market?

I am a firm believer in R&D as a fundamental factor in meeting advances in technology and dealing with market competition. Alongside this, to manage environmental and socio-economic aspects at a regional level, there is need to build links between industry, R&D and policy institutions. Technologies and solutions in the larger frame are baseline references to identify and prioritize actions. As we adopt a wholesome and co-optive approach, we will see markedly improved resilience of electro-mechanical equipment and infrastructure besides better operations, maintenance and outputs. There are several technologies at play in various segments of the renewable energy sector in India. A look at the sector overall and taking a generic, more academic approach, we can see that individual categories --- hydro, solar, wind keep optimizing their potential. And newer areas like green hydrogen are gaining traction. Taking a very outlier and over-arching view, in the longer term, I see very early movement towards a combination of advanced geothermal systems, small modular nuclear reactors, and innovative storage systems. The first two are capable of producing green hydrogen electrolytically. These technologies will come into their own in the 2030s. Meanwhile, technologies for carbon capture and storage/utilization as in technologies enabling capture of carbon under US$ 40 per tonne carbon dioxide are coming up. Balancing this, I see increasing penetration of intermittent and infirm renewables is leading to a move towards every grid ecosystem moving towards digital, cloud, IoT and AI technologies. Suffice it to say that there is a huge tectonic movement at work in every aspect of renewable energy which is looking at optimising output, mitigating environmental impact, fostering efficiencies of scale and integrating the various aspects and components of the sector into a cohesive, best impact role. We will see this play out over the next few years. There will obviously be a mix of various energy options and technologies.

> IN THE EARLY STAGES OF ANY TECHNOLOGY, SOLUTION OR ALTERNATIVE TO CONVENTIONAL SYSTEMS THE PRICE THRESHOLDS ARE HIGH

How can we address the cost concerns while helping customers realize the long-term benefits of solar power reserves?

In the early stages of any technology, solution or alternative to conventional systems the price thresholds are high. As adoption happens, the bar becomes lower. Solar power is no exception ---- the Government is hand-holding it, local manufacturing will grow and adoptions by consumers will make this the preferred source of power. The process has already begun.

Why are Solar Parks essential for building a smarter, more sustainable India?

The development of solar parks and ultra mega solar power projects is on the Government's agenda. The Ministry of New & Renewable Energy commenced these parks in 2014 with the idea of setting up at least 25 solar parks and ultra mega solar power projects. The aim was to create 20,000 MW of solar power installed capacity which was later enhanced to 40,000 MW in 2017. By 2025-'26 we should see these parks being actualised. Each solar park will have an installed capacity of 500 MW and above. With Solar Power Park Developer (SPPD) as the implementing agency, these parks are at the pivot of solar power in India.

What challenges, such as installation and maintenance, are being faced in the solar energy sector, and how can they be overcome?

Challenges woven into the rising annual demand for solar installations

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signify enormous underlying potential for the development of domestic solar module production.The Indian solar industry relies heavily on imports of solar cells, modules and solar inverters. At present, India's domestic manufacturing capacity is not enough to fulfil the solar target. India's cell-making capacity is a little over 3 GW a year. The module production capacity in the country is around five times that of solar cells. Demand for indigenously made solar cells is generally low because module suppliers demand cells of higher grade (in terms of wattage, efficiency, etc). In addition to this, due to the narrow cell production scale for most cell manufacturers, domestic cells are more expensive. Given these factors, domestic module suppliers prefer imported cells of superior quality. To get to the stated 2030 solar targets, India needs to install more than 250 GW of solar energy capacity in less than 10 years, or minimum 25 +GWp of solar energy capacity annually -- more than twice what has been achieved in recent times. Rapid targeted growth would require millions of solar modules and every solar module would need a steady supply chain of materials for manufacturing. The answer lies in jump starting a fast scaling solar power panel production in-country. Standalone EPC players will cater to ISPPs and corporations. This will increase demand for EPC players, as developers opt to outsource turnkey projects due to a lack of internal expertise. The EPC market is fragmented project sizes typically ranging from 10 to 25 MW. Scale-driven procurement efficiencies will diminish as rapidly declining costs and improving technology options inhibit the long-term framework agreements that characterize conventional-energy procurement structures. In addition to non-optimal policy and regulations, there are very considerable techno-economic risks in setting up and operationalising module manufacturing facilities. The manufacturing space is dominated by imports. Given global overcapacity in this segment, module-manufacturing facilities likely will not be built in India unless mandated by local regulations. If that happens, the lower-cost economics of Indian manufacturers could delay grid parity by two to three years. Global procurement is unlikely to remain a differentiator as more players achieve scale and become adept at it. A pool of low-cost project equity developed from retail or other cost sources can add up to a distinct advantage. Besides this, local design and engineering will play a major role in India's solar market. Eventually, global players will see the benefits of manufacturing locally and specifically for the Indian market. Competition from local players could further drive down systems costs. India's solar potential is real and the support environment is improving fast, to forecast a $6 billion to $7 billion capital-equipment market and close to $4 billion in annual revenues for grid-connected solar generators. Longer-term value will come from efficiently executed projects, low-cost (and often innovative) financing, and localization. In contrast to the global nature of the upstream industry (solar modules), local players will dominate the downstream side in the initial years; this includes project development, installation, and distribution. A vital aspect is module manufacturing facilities in-country. To be a global leader in solar energy India must create policy conditions for solar technology diffusion across the country, quickly. Going forward, we must also focus on emerging technologies such as monocrystalline, bifacial and half-cut cells, micro inverters and tracking equipment. These hold promise for disruptive gains in solar efficiency. EPC World

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Powering sustainable energy

With the government's ambitious targets for reducing greenhouse gas emissions and transitioning to cleaner energy sources, the integration of efficient energy storage solutions has become paramount. Despite the challenges posed by limited domestic reserves of essential materials like lithium and cobalt, recent discoveries and proactive government initiatives signal a promising path forward. This article explores the rise of lithium-ion batteries and the emerging alternatives that could redefine the country's mobility landscape

The government's push for greener energy has significantly accelerated the adoption of electric vehicles (EVs) and the development of renewable energy sources. However, to power EVs and effectively harness renewable energy, advanced battery technology is essential. In India, integrating renewable energy into the grid is an ongoing challenge, with several obstacles yet to be overcome. Batteries play a crucial role in this process by storing excess energy generated from renewable sources, ensuring it is available when needed, and mitigating the intermittency issues associated with renewable energy. India's journey with battery technology began with the traditional lead-acid batteries, which have been widely used in various sectors for decades. These batteries powered vehicles, inverters, and telecommunications infrastructure. Despite their widespread use, lead-acid batteries had limitations, including lower energy density, shorter lifespan, and environmental concerns due to lead content. The demand for more efficient, lighter, and environmentally friendly batteries became more pronounced with the rise of mobile phones, laptops, and other portable electronics. This led to the adoption of nickel-cadmium (NiCd) and later, nickel-metal hydride (NiMH) batteries. However, these technologies were soon overshadowed by the advent of lithium-ion (Li-ion) batteries, which revolutionised energy storage with higher energy density, longer cycle life, and faster charging times.

The rise of lithium-ion batteries

The energy landscape in India and across the globe has undergone substantial change in recent years. At the core of this evolution is lithium-ion battery technology, which has transformed the way energy is stored and utilised. Whether in personal electronics, electric vehicles (EVs), or large-scale energy storage applications, these batteries have become essential to both current energy needs and future advancements. Different types of lithium-ion batteries are available in India. Lithium cobalt oxide (LCO) batteries are widely used in consumer electronics such as smartphones, laptops, and cameras. Lithium iron phosphate (LFP) batteries are gaining traction in electric vehicles, especially for buses, trucks, and renewable energy storage. Lithium nickel manganese cobalt oxide (NMC) batteries are commonly used in electric vehicles and energy storage systems (ESS) due to its balanced performance in energy density and lifespan. Lithium nickel cobalt aluminum oxide (NCA) batteries are primarily used in high-performance electric vehicles, such as Tesla's battery packs, and Lithium manganese oxide (LMO) batteries are often used in hybrid and plug-in hybrid electric vehicles (HEVs, PHEVs), as well as power tools and medical devices.

Navigating challenges

The rise of lithium-ion batteries presents substantial opportunities but also comes with significant challenges. India has historically lacked domestic production of essential raw materials like lithium, cobalt, and nickel, leading to a reliance on imports from countries such as China, Chile, and Australia. This dependence creates vulnerabilities in the supply chain and can result in price volatility. However, recent developments have been promising.

In February 2023, the Geological Survey of India (GSI) identified 5.9 million tonnes of lithium in the Salal-Haimana area of Jammu and Kashmir's Reasi district, making India the seventh-largest lithium reserve globally. Furthermore, in July 2024, the Atomic Minerals Directorate for Exploration and Research (AMD) announced the discovery of 1,600 tonnes of lithium in Karnataka's Marlagalla area, with additional reserves found in Rajasthan and Jharkhand. The government has also taken proactive steps by passing the Mines and Minerals (Development and Regulation) Amendment Bill, 2023, and is planning further exploration efforts.

The fluctuating prices of materials like lithium, nickel, manganese, and cobalt contribute to the high initial cost of lithium-ion batteries, particularly in the electric vehicle sector. Although global prices have been declining due to technological advancements and economies of scale, affordability remains a significant barrier to widespread adoption in India, where cost sensitivity is a major concern. Recycling is becoming a vital component of the battery value chain, especially as the first generation of EV batteries begins to reach the end of their life cycles. Establishing an efficient recycling infrastructure is crucial, not only to address environmental issues but also to recover valuable materials, reducing the dependence on primary resource extraction. India is still in the early stages of lithium-ion battery recycling, which is key to achieving sustainability in this sector. The absence of an effective recycling infrastructure has led to environmental challenges and inefficiencies in material recovery, particularly for essential elements like cobalt and lithium. Developing a strong Li-ion battery recycling industry is critical to ensuring the long-term viability of this sector. Lithium-ion batteries contain valuable materials such as lithium, cobalt, and nickel, which can be recovered and reused in new batteries. Effective recycling practices help decrease reliance on virgin resources, lower environmental impact, and promote a circular economy for Li-ion batteries. The Indian government is taking proactive measures to build a Li-ion battery recycling ecosystem. In August 2022, the Ministry of Power introduced the Battery Waste Management Rules, enforcing Extended Producer Responsibility (EPR), which holds manufacturers accountable for the collection and recycling of batteries. Additionally, NITI Aayog, in collaboration with the UK government, developed a roadmap to support the growth of the battery reuse and recycling market. This roadmap outlines key strategies for creating a sustainable recycling ecosystem, including the establishment of collection centers, promotion of technological innovation, and encouragement of collaboration among stakeholders. These initiatives underscore India's commitment to developing a circular economy for Li-ion batteries and reducing the environmental impact associated with the rise of electric vehicles. In India's tropical climate, safeguarding the safety and thermal stability of lithium-ion batteries is of paramount importance. The high temperatures and humidity levels

prevalent across much of the country present significant challenges for battery performance, particularly in electric vehicles (EVs). Without a robust battery management system (BMS), lithium-ion batteries are at increased risk of issues such as thermal runaway - a condition where the battery overheats uncontrollably - leading to potential fires and a significantly shortened lifespan.

Emerging alternatives to lithium ion battery

This growing demand has spurred increased research and development efforts in battery technology. In recent years, batteries have become

the backbone of the technological revolution, powering a wide array of applications from smartphones to electric vehicles. The market for batteries in India is expanding rapidly. Taking note of the increasing demand, the government in 2021 launched Production Linked Incentive (PLI) scheme for National Programme on Advanced Chemistry Cell (ACC) Battery Storage. This scheme aims to enhance India's manufacturing capabilities for the manufacture of ACC. According to Mordor Intelligence, the India Battery Market is projected to grow from USD 7.20 billion in 2024 to USD 15.65 billion by 2029, reflecting a compound annual growth rate (CAGR) of 16.80% during the forecast period (2024-2029).

According to a report by the Central Electricity Authority (CEA) of India, the country's energy storage demand is projected to reach 60.63 GW/336.4 GWh by 2030. This includes 18.98 GW/128.15 GWh from pumped hydro storage and 41.65 GW/208.25 GWh from electrochemical storage.

India's reserves of lithium and other essential materials required for lithium-ion battery production are limited. To meet domestic demand, the country relies heavily on imports, primarily from China and Hong Kong. Reports indicate that India is the world's largest importer of processed lithium. In response to this dependency, India is making concerted efforts to secure a stable supply of lithium. As part of this strategy, the country has signed an agreement to acquire five lithium mines in Argentina. Additionally, the Ministry of Mines has established KABIL (Khanij Bidesh India), a joint venture involving the National Aluminium Company, Hindustan Copper, and Mineral Exploration & Consultancy. KABIL's mandate is to explore, acquire, and develop strategic mineral assets outside India to ensure a steady supply for domestic needs. As India advances towards its renewable energy goals and the electrification of its transportation sector, there has been a significant increase in research and development (R&D) efforts focused on battery technology. Several Indian institutions and startups are pioneering work on next-generation battery technologies. One promising area of innovation is solid-state batteries, which use solid electrolytes instead of liquid ones. These batteries offer higher energy density, enhanced safety, and longer lifespans. Indian startups and research institutions are actively exploring this technology, which has the potential to revolutionize electric vehicles (EVs) and grid storage solutions. Given the scarcity of lithium, sodium-ion batteries, which use sodium as an alternative to lithium, present a promising option. With its abundant sodium resources, India is well-positioned to lead in the development of this technology. Flow batteries, another area of exploration, are particularly suited for large-scale energy storage applications, such as integrating renewable energy into the grid. India is investigating the potential of flow battery technology to provide stable, long-duration energy storage solutions, which are crucial for supporting the country's growing renewable energy capacity.

Government policies and initiatives

In recent years, the Indian government has introduced several initiatives to accelerate the development of advanced energy storage technologies. In September 2023, the government approved the Viability Gap Funding (VGF) program, which provides a subsidy covering 40% of the deployment costs for energy storage projects awarded through competitive bidding. This program is designed to lower the overall costs of deploying energy storage systems. Additionally, the government has allocated funds to support the installation of approximately 4 GWh of battery energy storage systems, with a particular focus on

aiding distribution companies. Projects selected under this initiative are required to become operational within 18 to 24 months. Since the signing of the Paris Agreement on climate change, India has made significant progress toward creating a more sustainable future. The Paris Agreement, a global treaty involving nearly 200 countries, commits nations to work together to reduce greenhouse gas (GHG) emissions and combat climate change. Its goal is to limit global warming to well below 2°C, with an aspirational target of 1.5°C above pre-industrial levels. In line with the Paris Agreement, India has set ambitious targets to reduce carbon dioxide emissions. By 2030, the country aims to install 500 gigawatts (GW) of renewable energy capacity, which will account for approximately 60% of its total power capacity. Additionally, India plans to produce 5 million tonnes of green hydrogen by 2030 and has set a long-term goal of achieving net-zero carbon emissions by 2070.

To support its net-zero carbon emissions goal, the Indian government is focusing on the rapid expansion of electric vehicles (EVs). The government has introduced policies aiming for significant EV sales penetration by 2030: 30% for private cars, 70% for commercial vehicles, 40% for buses, and 80% for two- and three-wheelers. In 2015, the government launched the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME India) Scheme. Currently in its second phase, FAME II has a budget of INR 10,000 crore (approximately $1.2 billion) for a five-year period starting from April 1, 2019. To further strengthen domestic manufacturing of advanced automotive technology (AAT) products and attract investments across the automotive value chain, the government introduced the Production Linked Incentive (PLI) Scheme for the Automotive Sector in September 2021.

The Indian government has also been proactive in fostering the growth of battery technologies. The National Mission on Transformative Mobility and Battery Storage, launched in 2019, aims to build a robust ecosystem for battery manufacturing, including recycling and reuse. The mission also focuses on creating a policy framework that encourages innovation and supports startups in the battery technology sector. Another critical initiative is the Production-Linked Incentive (PLI) scheme for advanced chemistry cell (ACC) battery manufacturing. Under this scheme, the government has allocated substantial financial incentives to promote local production of advanced batteries, reduce reliance on imports, and stimulate technological innovation.

Road Ahead

Despite the progress, India faces several challenges in its quest to become a global leader in battery technology. The high cost of raw materials, dependence on imports for critical components, and the need for significant investments in R&D and infrastructure are some of the hurdles that need to be addressed. Moreover, the environmental impact of battery production and disposal is a growing concern. Developing efficient recycling technologies and establishing a circular economy for batteries will be crucial for sustainable growth.

Looking ahead, India's battery technology sector holds immense potential. With continued government support, industry collaboration, and innovation, India is well on its way to becoming a key player in the global battery market. The focus on developing indigenous technologies, combined with strategic international partnerships, will be essential in overcoming current challenges and driving the country towards a sustainable and electrified future.

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We are currently establishing a strong local supply chain

Our technology-driven solutions will play a crucial role in ensuring that water management systems are both sustainable and technologically advanced, says **RANDHIR CHAUHAN**, President, Orbia India

Can you elaborate on Wavin's sustained commitment in the Indian region, and how does the company's global expertise and experience benefit the Indian market?

Wavin's (Orbia's Building and Infrastructure business) commitment to the Indian market is deeply rooted in its long history and global expertise. Having established its presence in India as far back as 1964, Wavin has continuously invested in the region, recognizing the immense potential and unique challenges presented by the Indian market. Our extensive global experience of over 60 years in the building and infrastructure sectors equips us with the knowledge and innovative solutions necessary to address India's specific needs. This expertise, combined with our local manufacturing capabilities, enables us to deliver tailored solutions that are both technologically advanced and sustainable. Our commitment is further demonstrated by our ongoing efforts to expand our footprint across India, with significant investments in local supply chains and the establishment of manufacturing units. By leveraging our global expertise in water management, sanitation, and climate-resilient infrastructure, we are well-positioned to contribute to India's journey toward urbanization and sustainable development. Wavin's solutions are designed to ensure the highest standards of safety, efficiency, and environmental responsibility, aligning perfectly with India's infrastructural goals.

How is Wavin contributing to India's infrastructural development, and what specific initiatives is the company undertaking to support this goal, particularly in Tier II and III cities?

We see immense potential in India's infrastructural development, especially with the ongoing modernization of cities, the rise of smart cities, and the government's increased focus on infrastructure. The market is poised for significant growth, potentially achieving double-digit expansion in the near future. As India progresses towards enhanced urban infrastructure, Wavin's technology-driven solutions will play a crucial role in ensuring that water management systems are both sustainable and technologically advanced. Our wide range of innovative products has consistently demonstrated exceptional performance in maintaining robust and reliable water management systems, making

them ideal for the Indian market. We are currently establishing a strong local supply chain and assembling our commercial teams across the country. This includes continuous investment in the localized manufacturing of our major product range, which will significantly enhance our ability to serve the market more effectively. In addition to our ongoing efforts, we are also focusing on expanding our reach into Tier II and III cities. This expansion is a key part of our commitment to contributing to India's infrastructure growth and ensuring that our solutions are accessible nationwide.

To support this goal, we are implementing an aggressive marketing strategy designed to create awareness among key influencers such as plumbers, who play a critical role in the adoption of our products. Furthermore, our value-for-money product range is tailored to meet the needs of the diverse Indian market, ensuring that our solutions are not only effective but also affordable for a wide range of customers. Through these initiatives, Wavin is dedicated to playing a pivotal role in India's infrastructural development, particularly in regions that are poised for rapid growth and transformation

How does Wavin leverage technology and innovation to address India's unique challenges, and how do you think it is impacting the industry?

By leveraging cutting-edge technology and relentless innovation, we are addressing India's unique infrastructural challenges, particularly in water management and urban development. The pressing issues of water scarcity, aging infrastructure, and the growing need for climate-resilient cities demand advanced, sustainable solutions. Our approach is centered around ensuring efficient and sustainable water usage. With products like Tigris K5 and Tigris M5, which feature Acoustic Leak Alerts, we effectively prevent water wastage, making sure every drop is accounted for. Additionally, our solutions for storm water & rainwater harvesting management, such as Quickstream & AquaCell, are designed to support the sustainable growth of urban areas by reducing dependence on freshwater resources and enhancing the resilience of water infrastructure. Beyond water management, our innovations extend to building and infrastructure solutions that improve durability, safety, and energy efficiency in urban environments. For example, our noise-reducing brackets and high-density PE soil and waste systems set new standards in comfort and reliability, making them suitable for both large and small-scale developments. These advancements are not only reshaping the industry but also contributing significantly to India's transition towards smarter, more sustainable cities. By addressing these challenges with innovative solutions, we are helping to create a future where India's infrastructure is more resilient, sustainable, and aligned with the needs of both people and the environment.

What inspired Wavin to partner with Rohit Sharma as Brand Ambassador, and how does this partnership align with Wavin's commitment to the Indian market?

Wavin's partnership with Rohit Sharma as Brand Ambassador is a testament to our unwavering commitment to excellence and our long-term vision for the Indian market. We drew inspiration from Rohit's remarkable career and his reputation for delivering stellar performances under pressure. His leadership and achievements on the field resonate with Wavin's own values of innovation, quality, and durability. By joining forces with Rohit, we aim to amplify our brand's resonance with the nation's public and underscore our dedication to providing top-notch piping solutions and advanced water management systems. This partnership aligns seamlessly with our mission to address India's evolving plumbing and drainage needs, and it reinforces our long-term strategy to solidify Wavin's position as a leading player in the Indian market. Together, we are confident that our collaboration will create a lasting impact, driving us closer to our vision for the future in India.

How do you see the infrastructure industry evolving in India over the next 5-10 years, and what opportunities do you anticipate in the industry

The Indian infrastructure industry is poised for significant growth over the next 5-10 years, driven by rapid urbanisation, government initiatives, and the increasing demand for smart cities. As India continues to modernize its cities and expand its urban infrastructure, we anticipate a surge in opportunities within the sector. The focus will increasingly shift toward sustainable and technologically advanced solutions, areas where Wavin has a proven track record. One critical area of opportunity lies in the need to replace aging plumbing and drainage infrastructure, which not only leads to significant water wastage but also contributes to the contamination of freshwater resources. Wavin's high-quality products are designed to address these challenges effectively. Our advanced piping systems and solutions for water management, rainwater harvesting, and wastewater treatment ensure the efficient use and preservation of water, a vital resource in today's rapidly urbanizing world. As the industry evolves, we expect to see a greater emphasis on smart, connected solutions that address the challenges of climate change, water scarcity, and urbanization. Wavin is committed to playing a crucial role in this transformation, providing solutions that not only meet the current demands but also anticipate the future needs of India's growing cities.

EPC World

Mahindra unveils the All-New Veero

Mahindra Veero sets a new industry standard with first-in-segment tech and features such as a driver-side airbag, reverse parking camera, a 26.03 cm touchscreen infotainment system, steering-mounted controls, and power windows

Mahindra & Mahindra, India's leading manufacturer of utility vehicles and leaders in the LCV <3.5 t segment, has launched the Mahindra Veero, starting at ₹7.99 Lakh. Designed to redefine the LCV <3.5 t segment, the Veero offers unparalleled savings with best-in-class mileage, exceptional performance powered by robust multiple engine options, industry-leading safety features, enhanced occupant protection, and a premium cabin experience.

Mahindra's innovative Urban Prosper Platform (UPP) is India's first ground-up multi-energy modular CV platform. Designed to offer best-in-class total cost of ownership and segment-first safety beyond regulations, the platform sets a new benchmark in the industry. It is engineered to support payloads from 1 t to 2 t+ in multiple deck lengths and accommodates multiple powertrain options, including diesel, CNG, and electric.

Mahindra Veero sets a new industry standard with first-in-segment tech and features such as a driver-side airbag, reverse parking camera, a 26.03 cm touchscreen infotainment system, steering-mounted controls, and power windows. The Mahindra Veero also boasts best-in-class features, including a payload capacity of 1,600 kg, 3035 mm cargo length, 18.4 km/l* mileage for diesel, and a 5.1 m turning radius, making it highly versatile and ideal for urban operations.

Veejay Nakra, President of the Automotive Division at Mahindra & Mahindra, said, "The Mahindra Veero will further strengthen our leadership in the LCV <3.5 t segment. Built to help customers maximise earnings, it offers best-in-class payload, exemplary mileage, and superior maneuverability. With multiple segment-first technology and features, the vehicle ensures a premium cabin experience, unmatched safety, exceptional performance, and capability. The

All-New Urban Prosper Platform (UPP)

- Designed as India's first Multi-Energy CV platform, including Diesel, CNG, and Electric.
- Modular platform offering a range of payload options (1 to 2t+) and deck sizes.
- Delivers safety beyond regulatory compliance, advanced comfort, and unmatched TCO.

Mahindra Veero is designed to be a category disrupter ahead of all other offerings in this segment, truly living up to the promise of being 'Soch Se Aage'."

R Velusamy, President of the Automotive Technology and Product Development at Mahindra & Mahindra, said, "The Mahindra Veero, built on the all-new Urban Prosper Platform, is a testament to our commitment to innovation and versatility. Designed to support multiple powertrain options, including electric in the near future, it addresses the diverse operational needs of businesses, offering flexibility like never before. Safety has been a top priority in its development, with industry-leading standards ensuring maximum protection for all occupants. Engineered to excel in even the most challenging conditions, the all-new Veero sets new benchmarks in its category, especially in comfort, performance, safety, and long-term reliability."

Mahindra Veero is a bold statement for entrepreneurs who dare to think beyond the conventional. The positioning, "Soch Se Aage," encapsulates this spirit, as the vehicle goes beyond traditional expectations. The Mahindra Veero offers features and capabilities that the category has never witnessed, ensuring the well-being of customers and their prosperity while instilling pride of ownership. EPC World

Mahindra Veero with 'Soch Se Aage' Promise

Redefining the Light Commercial Vehicle (LCV <3.5 t) in every aspect, it is designed to set new standards in cost of ownership, capability, performance, safety, comfort, and technology.

- **Unmatched Savings:** Best-in-class mileage of 18.4 km/l* for diesel and an impressive 19.2 km/kg* for CNG, with best-in-class 20,000 km regular service intervals for maximum profitability. Connectivity with 50+ iMAXX features enhances productivity.
- **Exceptional Performance & Capability:** Class-leading payload capacity of 1,600 kg, with the option of a 1.5-litre mDI diesel engine that delivers 59.7 kW and 210 Nm of torque, or the Turbo mCNG engine with best-in-class power of 67.2 kW and 210 Nm of torque.
- **Segment-First Safety:** Features include a driver airbag, reverse parking camera, and adherence to the more stringent AIS096 compliance crash safety standards.
- **Premium Cabin Experience:** First-in-segment features include a 26.03 cm touchscreen, power windows, and steering-mounted controls. A spacious, comfortable, ergo cabin with a certified D+2 seating arrangement and a best-in-class reclining driver's seat.
- **Power of Choice:** Two fuel types (Diesel and CNG); two cargo lengths (3035 mm and 2765 mm); three cargo types (Standard Deck, High Deck, and CBC) cater to different business needs.

Amagua's project involved designing a self-sustainable, energy-efficient plant, using all solar panels to power the pumps.

Amagua CEM designs solar-powered water treatment and distribution network for Ecuador's Samborondón district

Using Bentley Technology saved USD 1.2 million in costs and helped eliminate 6,905 tons of carbon emissions

Adopting solar energy for a new integrated water system

Amagua CEM provides drinking water and wastewater management for the La Puntilla Parish in the Samborondón district of Ecuador. Committed to offering a quality, efficient water supply and sewerage service, they also provide complementary preventive system management, as well as consulting for network design, construction, and maintenance of residential facilities. To streamline operations and ensure a reliable water supply, Amagua decided to build an integrated water capture, transportation, and treatment system. "To have operational autonomy, we determined the need for an integrated collection, conduction, and treatment system that allows it to supply [...] a complete flow of 880 liters per second (l/s),"

Image courtesy of Amagua C.E.M

said Leonidas Dávila, engineer and project director at Amagua.

The project was divided into two phases, providing a flow of 440 l/sin the first phase and an additional 440 l/s during the second phase. It involved designing a catchment, distribution line, and treatment plant. To make the project self-sustainable and reduce its carbon footprint as much as possible, Amagua contemplated using solar panels to power the network and pump the water to the distribution tanks. The solar energy captured by the panels would power surface pumps that draw water from a river or well and pump it to the raw water tank and distribution system, reducing and potentially eliminating the network's reliance on conventional energy sources, such as grid electricity or fossil fuels.

Project Summary

Organization

Amagua CEM

Solution

Water and Wastewater

Location

Samborondón, Guayas, Ecuador

Project Objectives

- To deliver an integrated water capture, transportation, and treatment system.
- To achieve a more sustainable, economic water supply.

Project Playbook

MicroStation, OpenFlows Water

Fast Facts

- Amagua provides drinking water and wastewater management for La Puntilla Parish.
- They determined a need for an integrated water capture, transportation, and treatment network.
- The project involved designing a self-sustainable, energy-efficient plant, using solar panels to power the pumps.

ROI

- Using MicroStation and OpenFlows Water optimized design, shortening the construction period by 97 days.
- Bentley's applications reduced Amagua'smodeling time by 80% and saved on material costs.

Image courtesy of Amagua C.E.M.

Using MicroStation and OpenFlows Water optimized design, shortening the construction period by 97 days.

By harnessing solar energy, the environmental impact is reduced, and a more sustainable and economical water supply is achieved over the long term

- Leonidas Dávila Viera,
Engineer and Project Director,
Amagua CEM

Addressing undulating terrain and pipeline transients

While solar panels are advantageous to reducing environmental impact and supporting a more sustainable and economical water supply, Amagua needed to consider several factors to optimise pump and network operations. "It is important to consider the appropriate capacity and size of solar panels, as well as the efficiency and capacity of storing energy in batteries, for optimal operation of the pump system," said Leonidas Dávila. In addition to the panel specifications and energy considerations, Amagua also had to address semi-undulating terrain and irregular topography, as well as avoid problems with transients in the 4.2-kilometer-long pipeline in the high elevation area.

To identify and mitigate potential problems that could affect the pressure and flow and compromise operations, as well as ensure that the solar panels could generate the necessary power to deliver a reliable water supply, Amagua had to perform various modeling scenarios. They needed an integrated 3D design and hydraulic modeling and analysis solution to optimise optioneering, determine the most effective network arrangement, and validate the use of solar energy.

Leveraging Bentley's 3D design and hydraulic modeling and analysis applications

"It was proposed that MicroStation and OpenFlows Water be used to optimize the execution of the project," said Leonidas Dávila. Amagua selected MicroStation to design the entire architecture of the system in 2D and 3D, as well as OpenFlows Water to model and analyse the pipeline arrangement of the network and estimate energy consumption costs, based on both electricity and renewable energy. The advanced algorithms and 3D visualisation features of Bentley's applications allowed Amagua to perform digital simulations of numerous scenarios, verifying the optimisation of both the existing and future distribution networks, and validating the use of solar panels as the most efficient source of renewable energy. "Thanks to the usefulness of OpenFlows Water's energy cost module, we were

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Image courtesy of Amagua C.E.M.

Bentley's applications reduced Amagua's modeling time by 80% and saved material costs.

able to model energy costs when using fossil fuels and when using solar panels, as well as their contribution to the carbon footprint," said Leonidas Dávila. The digital models will also be used throughout the construction and operations phases of the project.

Digital simulation reaps savings and supports sustainability

Using Bentley's advanced 3D design and hydraulic modeling and analysis applications, Amagua reduced modeling time by 80%. Working in a connected digital platform improved efficiencies in data federation and data exchange processes by 75% and 80%, respectively. Through accurate modeling and simulation, Amagua shortened the planning stage by 15 days, identifying and eliminating 3,530 collisions during the design phase that was equivalent to a potential savings of USD 50,000. The integrated technology solution shaved 97 days off the construction schedule to save USD 1.2 million while achieving an optimal design that saved 40,000 tons of concrete.

In addition to time, cost, and material savings, the digital simulations supported the use of solar panels, delivering significant environmental and sustainability benefits by reducing energy consumption and the carbon footprint of the project. The solar panels reduced dependency on fossil fuels, eliminating 6,905 metric tons of carbon emissions. "As a result, we were able to achieve a 95% reduction in fossil fuel energy used per year," said Leonidas Dávila. Compared to conventional pumping systems, the solar-powered pumps are easier to maintain and are especially useful in rural or remote areas where electrical infrastructure may be limited, providing autonomous and reliable access to drinking water, improving the quality of life for communities. "The use of water pumping systems with solar panels offers significant environmental, economic, and social benefits," said Leonidas Dávila. EPC World

Neda Simeonova is a senior product marketing manager, Water Infrastructure, at Bentley Systems. Neda has been involved in the water, wastewater, and stormwater infrastructure industry for over 18 years, including as the former editorial director of Water & Wastes Digest, Storm Water Solutions and Water Quality Products magazines where she focused on industry trends, technology advancements, and water policies.

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