Cleantech HERO

JAN - FEB 2026
Issue no. 8

BESS + SOLAR - Managing DSM Penalties

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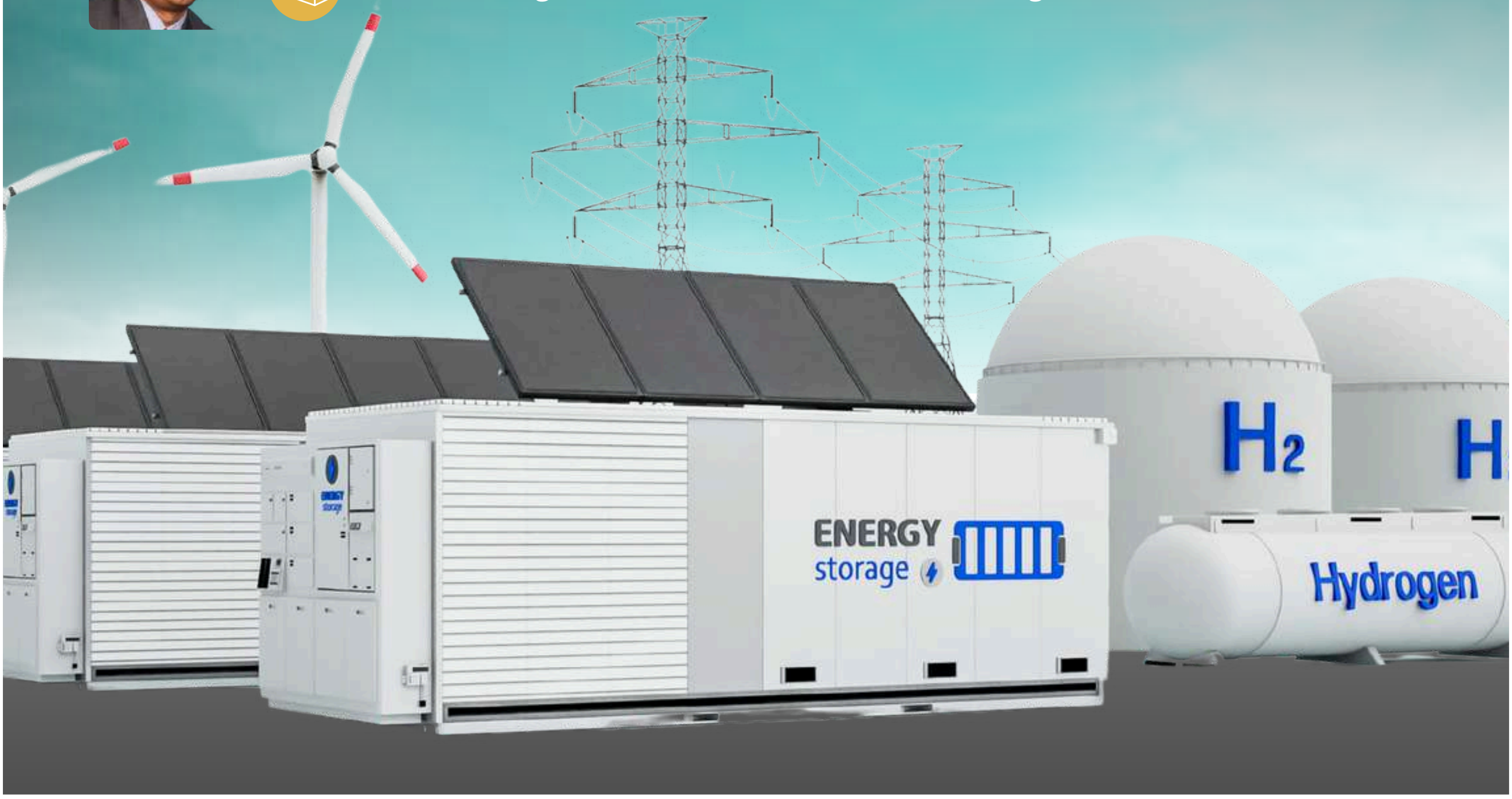

What's
INSIDE

Disclaimer

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Integrating BESS With Solar Plant to Reduce DSM Penalty and Monetize Clipping Power

This article highlights the strategic role of Battery Energy Storage Systems (BESS) in reducing DSM penalties and monetizing clipped solar energy. Backed by project-level insights, Arunav emphasizes how BESS enhances financial performance and grid reliability.

DSM charges (**Deviation Settlement Mechanism**) can be a significant drag on a renewable energy project's revenue. Some reports indicate that **DSM penalties can range from 0.3% to over 1.5% of annual generation revenues**, and in some cases, even higher for projects with poor forecasting accuracy. Reducing errors beyond 20% deviation and achieving higher accuracy within ±10% for solar and hybrid, and ±15% for wind, presents significant challenges.

Analysis of existing project data indicates that more than 85% of the time, errors remain within these ranges. Achieving further accuracy within these bounds would necessitate substantial technological advancements in forecasting tools and access to highly precise weather. This results in substantial financial losses, potentially millions of rupees per year for a large-scale solar or wind project. Integrating BESS has a direct and significant impact on reducing DSM penalties.

How Battery Storage Can Reduce DSM Penalties

Installing a battery energy storage system (BESS) along with a solar or solar plant is one of the most effective ways to reduce DSM penalties. BESS provides the flexibility to manage the intermittent nature of RE generation and align it with the scheduled output.

Here's how a BESS helps:

- **Reducing Over-injection**: When the plant generates more power than scheduled, the BESS can absorb and store excess energy rather than injecting it into the grid. This prevents the project from losing revenue or paying penalties for over-injection beyond the acceptable limits. The stored energy can then be discharged later.

- **Preventing Under-injection**: During periods of low generation (e.g., cloudy weather, low wind), the BESS can discharge its stored energy to compensate for the shortfall. This ensures the plant meets its scheduled output, avoiding the penalties for under-injection.

Savings in DSM Penalty

A study by TERI SAS indicated that BESS integration can lead to an **optimal reduction of DSM penalties by 45.19%.** Ideally, the target should be to reduce the penalty by 90%. So, for a solar plant of 500 MW with 22% CUF and a DSM penalty of 1.5% of revenue, **savings on the DSM penalty could be ₹3.25 Crore per year (90% DSM penalty savings).**

- For the 500 MW plant with 22% CUF annual generation would be 963600 MWh.

- Assuming a PPA tariff of ₹2.5/kWh, the **penalty would be ₹3.61 Crore per year.**

Integrating BESS With Solar to Monetize Clipping Power

Clipping loss occurs when a solar plant's DC-side generation exceeds the rated capacity of its AC-side inverter. Solar plants are often "oversized" with a DC-to-AC ratio (DC overloading) greater than 1. This means that for a solar plant with 1.4 DC overloading, the total DC capacity of the solar panels (e.g., 140 MWp) is higher than the AC-side inverter and grid-connected capacity (e.g., 100 MWac). Here, the **excess energy is not converted to AC power and is 'clipped' or lost.**

A certain degree of clipping is often accepted as a trade-off for improved overall energy yield and better inverter utilization. The amount of clipping loss is directly dependent on the DC/AC ratio and the intensity of solar irradiance at the plant's location. **A DC/AC ratio of 1.2 typically results in clipping losses of about 0.25%.** However, as the ratio increases, the potential for clipping increases. A DC/AC ratio of 1.5, for example, can result in annual clipping losses of 2% to 4%.

In India, which is characterised by high solar radiation levels (typically 1,600-2,200 kWh/m^2 annually), the impact of clipping can be more pronounced. Studies suggest that oversizing the DC capacity beyond 1.4 DC overloading can result in clipping losses of 1.5% to 3% without a tracker during peak sunshine hours. **With a single-axis tracker installed,** which results in an almost 15% increase in generation, clipping losses can range from 4-5%. Common clipping loss for a well- designed plant in a high-irradiance region of India is **around 1% to 2.5% of the total annual generation.**

BESS is crucial for monetizing this clipped energy. It acts as a buffer, absorbing surplus electricity during peak solar hours and releasing it during peak hours. The integration of BESS with existing solar plants can not only reduce revenue losses from wasted power but also generate additional revenue by dispatching it to the grid when it is most valuable, typically during evening peak demand hours.

Let's look at how much revenue can be generated for a 500 MW solar plant with a 2% clipping loss if BESS is integrated.

- **Clipping Loss in a Typical 500 MW with 22% CUF Solar Plant in India**: For the 500 MW plant with 963600 MWh of annual generation, a 2% clipping loss would be 19,272 MWh per year.

- **Revenue from Storing Clipping Power**: Storing this clipped energy in a battery allows it to be used later, either to fulfil the scheduled power or to sell it during peak hours when electricity prices are higher.

  Assuming a PPA tariff of ₹2.5/kWh, the potential revenue loss from clipping is:

  - 19,272 MWh x ₹2,500/MWh = **₹4.81 Crore per year.**

  By storing this energy and selling it at a conservative average price of ₹3.30 /kWh, going by the latest discovered tariff of Solar + BESS tender, the potential revenue that can be generated is:

  - 19,272 MWh x ₹3,300/MWh = **₹6.35 Crore per year.**

  The **overall revenue** from storing the clipping power in a battery and selling it later during peak hours is **₹11.16 Crore per year** (**₹4.81** + **₹6.35**).

Integrating BESS with an existing solar plant simply to store clipping power will not justify the cost. For only storing clipping power, considering a 500 MW solar plant with a 2% clipping loss, which would be around 53 MWh, a 73 MWh battery will be needed (**Consideration for battery sizing: 85% RtE, DoD - 85% and Yearly Degradation - 1.5%).** The cost of a 73 MWh battery at ₹1.5 Crore/MWh is ₹110 Crore. So, the payback period would be close to 10 years.

But the problem is clipping loss will be there only in about 5-6 months in a year especially the peak summer months when clipping loss goes up to 10% which when spread out through the year result in an average 2% of the total generation. So, the battery will remain unutilized for the rest 5-6 months of the year when there is no clipping loss.

A PPA for energy stored in battery where it is charged only from clipped power is simply not an option since the developer has to pay high penalty for not meeting the availability criteria as clipping power is available only for 5-6 months. So, for the rest of the months, the battery has to be charged by buying power from the market or installing additional modules. Buying power from the power exchange to charge the batteries is a better option (**though enabling regulations are required for energy accounting and metering for such an arrangement**) than installing additional modules as it requires extra space for which land should be available.

The integration of Battery Energy Storage Systems with solar plants is a strategic transformation that addresses multiple revenue challenges simultaneously. With the potential to reduce DSM penalties and capture lost clipping power, BESS integration offers compelling economics that extend far beyond simple energy storage.

The views expressed in this article are solely those of the author and do not necessarily reflect the views or positions of any affiliated organizations.

Ravin Mirchandani

Executive Chairman - Ador Powertron

Efficient Power Conversion for Hydrogen Initiatives | **YonderH2**

***Ravin Mirchandani, Executive Chairman, Ador Powertron Limited,** shares his take on the role of power conversion in enabling reliable, scalable green hydrogen production. By mapping YonderH2's role in the production chain and discussing global bottlenecks, market dynamics, and project reliability, he explains where YonderH2 fits in the renewable-to-hydrogen value chain and how power quality directly shapes electrolyser performance. The article also explores how India-led manufacturing is supporting emerging hydrogen markets in Europe and beyond.*

Where do YonderH2's products sit in the green hydrogen production chain?

If you look at a green hydrogen plant end-to-end, YonderH2 sits exactly where electrons become molecules. On the left, you have the renewables – solar, wind, and hybrids. On the right, you have the electrolyser stacks, water treatment, compression, storage and end-use. **We occupy the middle layer: we are the electrical backbone between the renewables and the electrolyser**. Power Converters are 20% of the total cost of the electrolysers.

Our portfolio – **converter transformers, thyristor and IGBT-based rectifiers** – takes AC power from the renewable sources, conditions it, and delivers highly stable, tightly controlled DC that the electrolyser stacks need for efficient, long-life operation.

So, we don't manufacture electrolysers or handle gas; we make sure every electron that reaches the stack is at the right voltage, current, and quality, 24/7. That's the part of the value chain YonderH2 is dedicated to – being the most trusted **DC power partner for green hydrogen projects** globally.

Electrolysers are the heart of hydrogen production. What does 'failure' look like if power conversion isn't done right?

When power conversion isn't done right, the electrolyser doesn't just lose a bit of efficiency – the whole plant underperforms. Poor power quality – too much ripple, sudden spikes, slow reaction to changes – directly affects the core of the electrolyser, the cells where water is actually split into hydrogen and oxygen. That's where you get extra heat, stress on materials and faster ageing. In real life, this means more unexpected shutdowns, more maintenance, and having to replace those core modules much earlier than planned.

From an investor's or owner's point of view, that's what "failure" looks like: you've spent the capex, the plant is built, but it never quite delivers the green hydrogen output, reliability or lifetime that was in the original business case – and the cost per kilo which was calculated initially for the green hydrogen quietly moves in the wrong direction.

What are the biggest bottlenecks preventing faster commercialization of green hydrogen projects – and where does power conversion fit into solving these?

If you look at the market today, the bottlenecks are less about whether green hydrogen works and more about how fast we can make it bankable at scale. We are in what I like to call a **"hydrogen winter" – a pause where a lot of announcements are being sorted into a smaller number of serious, financeable projects.** The brakes today are quite clear: policy and incentive frameworks are still evolving, equipment costs and technologies (especially with very aggressive Chinese price curves) are moving targets, and boards are understandably cautious about long-term performance, uptime and offtake contracts before signing large cheques.

The positive side is that none of this is fatal – **it's exactly the kind of consolidation phase every new energy technology goes through.** This is where disciplined engineering really matters, and that's where power conversion comes in.

If we can give developers and lenders high-efficiency, highly reliable DC power blocks that protect the electrolyser, follow renewables gracefully and behave predictably over 10-15 years, we take a big chunk of technical and economic uncertainty off the table. In other words, policy will catch up, costs will keep falling, but projects will move faster wherever the "plumbing" – including DC power – is robust enough that investors can trust the kilo-of-hydrogen that comes out of electrolysers will look like the one in their financial model.

You have positioned YonderH2 as focused 'solely on DC power sources'. Can you walk us through the synergies with the overall technical competencies of the Ador Group?

When we say YonderH2 is "solely focused on DC power sources", that doesn't mean we're a narrow company – it means we've taken the strongest part of Ador Powertron's technical DNA and pointed it squarely at green hydrogen. Ador Powertron has spent three decades building some of the most demanding power-electronics systems in India – ESP transformer-rectifier sets for emission control, MW-scale DC supplies, EV fast chargers, battery formation and testing systems, military-grade UPS and power supplies. **All of this is built on one common core tech stack:** AC-DC conversion and grid interface, high-current rectification and DC-DC conversion, digital controls, thermal management, safety, and power-quality engineering.

YonderH2 sits on top of that same core stack and specialises it for electrolysers. The converter transformers, thyristor and IGBT rectifiers, and DC-DC converters we supply to hydrogen projects are direct descendants of Ador Powertron's industrial power platform – just optimised for low ripple, tight voltage control and 24/7 hydrogen duty. The technology was literally born out of our long history in industrial power conversion and then refined into a globally deployable, field-proven solution for green hydrogen. So, the synergy is simple: **YonderH2 keeps a sharp, exclusive focus on DC power for electrolysers; Ador provides the deep bench – R&D, IP pipeline, manufacturing scale, and multi-sector experience from hydrogen, EV charging and battery tech.**

You mention low ripple output and voltage stability features. Can you quantify what this means in practice-how much efficiency does an Electrolyser gain with your systems?

An electrolyser, at its core, is a very large electrochemical machine that wants one thing from its power supply: clean, steady DC current. When that DC becomes "noisy" – too much ripple, drifting voltage – two things happen. First, you waste energy: more of the input power is converted to heat inside the cells rather than hydrogen. Second, you shorten the life of the electrolyser, because you are effectively subjecting the cells to thousands of small stress cycles every day.

Independent studies on alkaline and PEM electrolysers show that high-ripple, loosely controlled power supplies can easily cost a couple of percentage points in efficiency at full load, and significantly more at part load, compared with a well-filtered, well-regulated DC source. That is exactly why we focus so much on low ripple and tight voltage control at YonderH2.

Our DC blocks are engineered to keep ripple typically below about 3% and to hold voltage in a very narrow, predictable band across the operating range. In practice, that means more of every megawatt you buy is actually splitting water, not heating hardware, and your electrolyser runs closer to its intended lifetime instead of being worn out early by poor power quality.

You have a 500 MW manufacturing facility in Pune. What's your utilisation rate, and what would it take to justify expansion beyond this capacity?

As an organization we took a very deliberate decision to build ahead of the curve. **The 500 MW facility in Pune was designed as a multi-year runway, not something we would fill in year one.** Today, utilisation is healthy and steadily ramping, but we still have meaningful headroom by design – that's what allows us to take on large, lumpy hydrogen orders in India and Europe without worrying about whether the factory can cope.

What would trigger expansion beyond 500 MW? Two things together: first, a visible **multi-year order book** (repeat programmes), not just one-off projects – that keep the existing lines busy on a sustained basis; and second, **clearer policy support in key markets** so that large hydrogen programmes don't stop-start with every regulatory change. When those are in place, our next step is a brownfield expansion on the same campus: duplicate lines and more high-power test bays.

Can you walk us through the geographical footprint of your deployments?

In our home market, India, YonderH2 is embedded in almost every serious early green hydrogen initiative – from mobility pilots and refuelling stations to industrial projects and upcoming large-scale plants. That's where a big part of our 60 MW-plus of installed DC power capacity sits today. This is also where we learned to engineer for tough grid conditions, high ambient temperatures, dust and very real-world uptime expectations.

In Europe, we've moved **well beyond "pilot projects."** We have systems **running in Germany, Denmark, Italy, Greece and Lithuania**, working with electrolyser OEMs, EPCs and energy developers in what are arguably some of the most demanding power-quality and grid-code environments in the world. These aren't one-off boxes we shipped and forgot about; they're the start of long-term platform relationships where our DC power blocks are being standardised across multiple projects. So, our footprint today is India plus a growing European cluster – engineered and manufactured in India, made for the world – all running on the same YonderH2 technology platform and built out of our **500 MW facility in Pune.**

India vs. Europe: Where do you see faster adoption over the next 3-5 years?

Actually, I don't see this as a race, whether Europe is "ahead" or India is "catching up." **I see two very different types of leadership emerging over the next 3-5 years.** In Europe, adoption will be driven by regulation and decarbonisation law. They have legally binding climate targets, industry-wide hydrogen quotas, and instruments such as the Hydrogen Bank and H2Global. That means a certain volume of projects has to happen, and we're already seeing large industrial plants moving from PowerPoint to construction. It's a very policy-led curve.

In India, the story is different – and in many ways more exciting. We have ultra-competitive renewable power (2nd-best pricing in the world after China), a national mission focused on green hydrogen, SECI auctions for both production and electrolyser manufacturing, and very ambitious private players who are thinking not just domestically, but also for export to Europe and Asia.

From a small installed base, that can translate into very rapid adoption once the first few large projects are online. We already see that on the ground – YonderH2 is powering most of the first serious projects in the country, and to the best of our knowledge, **we're still the only Indian company to have crossed 60 MW of DC power sources supplied to green hydrogen plants.**

So, my answer is: Europe and India will both adopt fast, but in different ways. **Europe will be regulation-led, India will be cost-led and export-led**, and European tech with Indian manufacturing would be an ideal situation to counter the most competitive Chinese pricing. As YonderH2, engineered and manufactured in India and field-proven in Europe, we're deliberately positioned so that whichever curve bends up faster, the DC power backbone is ready - with a very strong bias in our hearts toward making India a serious global hydrogen player.

Dr. Seema Sukhani

Co-founder & Director - Tellus Habitat

Transforming Wastewater Solutions: Urban Sanitation

Dr Seema Sukhani, *Co-founder and Director at Tellus Habitat, discusses how decentralised,* ***bio-microbial wastewater systems*** *are reshaping urban sanitation in India. Drawing on her* ***IISc Bengaluru*** *training in environmental engineering, she highlights low-energy, chemical-free solutions that reduce environmental impact. Dr Sukhani outlines Tellus Habitat's journey from technological innovation to policy alignment and emphasises how decentralised systems advance circular economy goals, strengthen climate resilience, and enhance water security in rapidly growing Indian cities.*

Many wastewater treatment systems rely heavily on chemicals and high energy inputs. How does Tellus Habitat's microbial approach work?

Traditional STPs often rely on chemical dosing (alum, PAC, chlorine) and high-energy aeration, which create secondary pollution and high operational costs. **Tellus Habitat's microbial consortia and biofilm-based treatment eliminate chemical dependence, minimise sludge generation, and cut energy demand by up to 40%.**

This biological-first approach redefines "clean technology" by making treatment regenerative rather than extractive, aligning with principles of ecological engineering and climate resilience.

Tellus Habitat uses a pulse-mode bio-microbial process and IoT monitoring—how do these technologies compare in efficiency and reliability to traditional STP systems?

The pulse-feed microbial process creates controlled anoxic-oxic conditions, boosting nutrient removal and reducing aeration time. Compared to conventional STPs, which run continuously at high loads, R3H2O achieves higher reliability, lower downtime, and up to 30% lower OPEX. Treatment cycle (typical 6-8 hours batch):

- Screening & Equalization → solids removed.
- Pulse-Mode Biological Treatment → microbial action in cyclic aerobic/anaerobic conditions.
- Polishing (gravel + carbon + water bed) → final polishing & disinfection.
- Water Reuse → routed for flushing, gardening, or recharge.

How do you see decentralized STPs contributing to circular economy models in urban areas—particularly in water-stressed regions?

Decentralised STPs & the Circular Economy - With **97% water recovery, decentralised systems transform wastewater into a local water source.** In water-stressed cities, they reduce dependence on freshwater tankers, mitigate groundwater depletion, and create closed loops for toilet flushing, landscaping, cooling towers, and urban lakes. Beyond water, the minimal sludge generated can be co-composted, reinforcing circular urban metabolism and reducing waste footprints.

Could you elaborate on your revenue model—particularly the balance between product sales, maintenance contracts, and consulting services?

Tellus Habitat operates on a blended model of product sales, annual maintenance contracts (AMC), and consulting/advisory services. Initially (2021-2022), revenue was largely project-based, driven by **sales and installations**. As systems matured, **recurring revenues from O&M contracts** (20-25% of revenues today) became a key stabiliser. **Consulting and advisory services** for lake rejuvenation, public sanitation, and policy inputs contribute another 10-15%. The model has evolved from one-time sales to a lifecycle engagement approach, ensuring both financial sustainability and long-term environmental impact.

How many units have been deployed so far? What is the average capacity and scale of these installations?

Since inception, **40+ units have been deployed** across residential complexes, tech parks, schools, government facilities, and eco-tourism sites in states like Karnataka, Goa, Maharashtra, and Bihar. Capacities range from **5 KLD to 250 KLD**, with an average of **50-70 KLD.** Larger pilots (e.g., public toilets, coastal management sites) are underway. [data as of Sep 2025]

What regulatory or policy shifts would most accelerate the adoption of decentralized, chemical-free wastewater systems in India? Which existing schemes do you align with?

One of the biggest regulatory shifts that could really accelerate the adoption of decentralized, chemical-free wastewater systems in India would be **mandating decentralized sewage treatment plants (STPs) for housing societies with more than 50 units, as well as for public toilets.** That kind of requirement would push adoption at the grassroots level. Another key enabler would be **government incentives—specifically targeted at promoting chemical-free, zero-sludge technologies.** That would not only encourage innovation but also make it more viable for developers and municipalities to adopt sustainable solutions.

From a policy alignment perspective, we're already working closely within the frameworks of major national schemes like **AMRUT 2.0, the Swachh Bharat Mission (SBM), and the Jal Jeevan Mission.** We see a strong synergy, especially with SBM's emphasis on faecal sludge management and AMRUT's focus on urban water reuse. These missions are setting the direction, and we're making sure our solutions are closely aligned with those goals.

Have you explored or secured climate finance or impact investment? How important is ESG-focused capital in scaling clean technologies like yours in India and beyond?

Tellus Habitat is actively exploring impact investment, CSR partnerships, and green funds. ESG-focused capital is crucial as our systems directly reduce GHG emissions (lower energy/chemicals), water stress, and AMR risks. We see strong potential in climate-linked funds and carbon credit mechanisms tied to wastewater reuse and avoided emissions.

Your system claims compliance with CPCB and WHO standards—could you share more about the certification process, any audits you undergo, and how these benchmarks influence your system design or upgrades?

R3H2O systems are designed to comply with **CPCB discharge norms (BOD <10 mg/L, COD <30 mg/L)** and align with WHO reuse guidelines. Independent lab audits and government testing (e.g., Karnataka State Pollution Control Board, Goa State PCB) validate performance. These benchmarks drive continuous upgrades in microbial formulation, process integration, and polishing stages, ensuring global-standard compliance.

What are your plans for scaling operations in the next 2-3 years?

Over the next 2-3 years, our focus is very much on scale—both in terms of reach and operational capability. We're aiming to expand to over 100 installations, with a particular emphasis on public toilets, eco-tourism destinations, and smart campuses. To drive this growth, we're actively exploring strategic partnerships with Urban Local Bodies, Smart City Missions, and even tourism departments. We're also setting up dedicated manufacturing and service hubs, initially in South and West India, to enable faster deployment and reduce turnaround times. On top of that, we're leveraging digital O&M platforms to enable predictive servicing and more efficient maintenance across all our installations.

From Petro-Dollars to Lithium-Dollars: Why India Must Accelerate **Indigenous BESS Manufacturing**

Venkat Rajaraman
Founder & Director, Cygni Energy

As recent BESS tenders reflect aggressive pricing assumptions, China's Special Action Plan threatens to tighten lithium supply and disrupt cost forecasts. Venkat examines India's current import dependence and global market shifts that may impact domestic projects. He outlines critical policy interventions needed in the upcoming Union Budget—including differentiated customs duties, clear HSN classifications, and a tailored PLI scheme—to achieve true BESS self-reliance.

Atma Nirbhar Bharat emphasises self-reliance through strong domestic capabilities, and local manufacturing of BESS is central to this mission. However, India's dependence on BESS imports is high because domestic cell manufacturing is still nascent, and most active cells/packs are imported—predominantly from China. In FY 2023–24 India's lithium-ion battery import bill was **₹24,346 crore** (≈USD 3.0 billion), and **imports have continued to grow into 2024-25** with a rough estimate of **₹29,200–31,650 crore** (≈ US$3.5–3.8 billion).

Because imports fall under multiple HSN codes and varying customs classifications, covering cells, packs, sub-components, and consumables, a reliable consolidated import bill is not available in the public domain. This import dependence means India is effectively moving from an era of "petro-dollars" to a new vulnerability of "lithium-dollars" concentrated in China's supply chain. Domestic PLI and licensing deals are accelerating local cell projects, but large-scale self-sufficiency is still emerging.

Recent tender volumes have been large and accelerating. **As of Nov 2025, 75 GWh of BESS Capacity tenders (excluding cancelled tenders) have been shared, of which 55 GWh have been awarded and/or are in various stages of execution, and 20 GWh are in the tendering process.**

There continues to be considerable **ambiguity in the customs classification of various BESS sub-components**—including HV busbars, HV junction boxes, cooling systems, and sensor assemblies—which results in inconsistent duty assessments across ports and consignments

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To address this, we need a clear Government notification specifying the correct HSN codes, duty applicability, and import treatment for these items. **We also need a differentiated duty structure:** lower duties for subsystems not yet manufactured in India (such as CCS units and chillers) and higher duties for components that are easily manufacturable domestically.

The recent round of **BESS tenders in India**—spanning standalone BESS, Solar-BESS hybrids, FDRE, and RTC—has seen **unusually low prices.** While declining battery prices in China are often cited as the primary driver, the reality is more nuanced. Developers are also taking aggressive, forward-looking positions on the future trajectory of lithium and cell prices, **assuming continued reductions over the next 12-24 months.** However, these assumptions may not hold in full, especially in light of the recent policy actions and market interventions by the Chinese government, which could affect pricing stability, export dynamics, and supply availability. As a result, **today's bids may reflect optimism that does not entirely align with emerging-market signals.**

China's Special Action Plan, launched on 12 September 2025, sets an ambitious target to add over 180 GW of new-type energy storage by 2027, solidifying China's position as the world's largest BESS market. With China already crossing 100 GW of new-type storage by mid-2025, the plan requires an additional 80 GW (≈200–240 GWh) to be deployed in just 2.5 years. Given that over 97% of all new storage in 2024 was lithium-ion, this policy cements lithium-based BESS as the anchor technology.

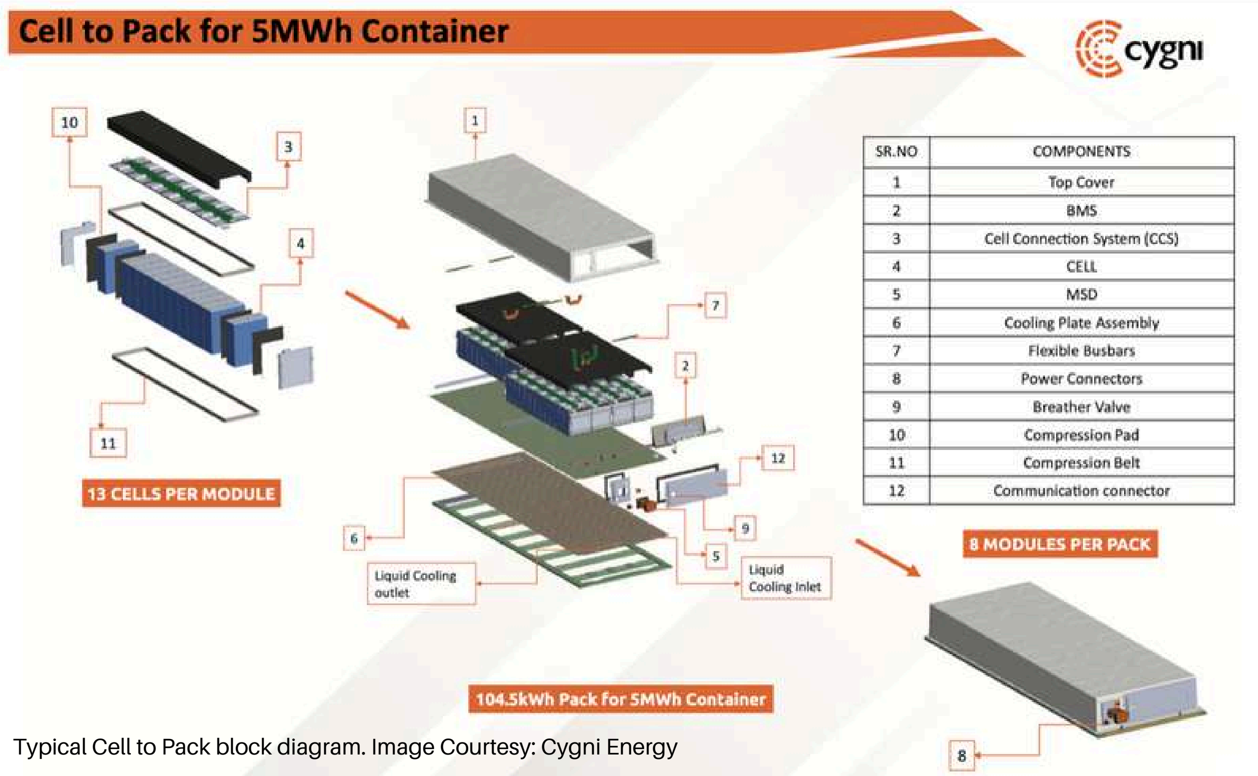
For the industry, this becomes the new baseline for capacity planning, raw-material contracting, and supply-chain investment. The plan also mobilises **¥250 billion** (~**$35 billion**) in project investments. The aggressive storage expansion will significantly increase domestic Chinese demand for lithium carbonate, LFP materials, and battery-grade raw materials.

Until now, many global developers have bid aggressively in tenders, assuming that lithium and cell prices will continue to decline. However, **China's new policy shifts the equation:**

- Demand for lithium will rise, tightening supply in the medium term.
- Chinese producers may redirect more material to domestic projects, reducing export flexibility.
- The government's industrial policy focus could stabilize or even push up lithium prices, contrary to expectations of a sustained fall.
- International BESS cost forecasts that assumed sharp lithium declines may now need revision.

In short, the Special Action Plan is a demand accelerator. While global developers have been banking on cheaper batteries, **China's domestic consumption surge could slow price declines or even create mild upward pressure on lithium prices over the next 12-24 months.**

India's EV ecosystem has helped build a strong base of suppliers for many BESS components, but **true indigenous BESS manufacturing—especially Cell-to-Pack—is far more complex.** It demands precision parts, advanced compression and bonding engineering, robust thermal management, and, now, large-scale fire testing mandated by CEA. Add to this the need for domestically developed EMS software, and it's clear that India must rapidly scale its capabilities. **While challenging, successful localisation can yield 6-8% cost savings per container.**



Typical Cell to Pack block diagram. Image Courtesy: Cygni Energy

The ask from the policy makers and in the upcoming union budget, for local Manufacturing of BESS must include a differentiated-duty and customs-classification framework to support BESS localization — with lower tariffs on critical subsystems (e.g., CCS, chillers, battery management electronics) that India cannot yet manufacture, and higher duties on easily domestically produced components (e.g., harnesses, sheet metal). A clear, unified customs notification must define HSN codes and duty assessment to eliminate ambiguity at ports.

We also urge the introduction of a **tailored PLI scheme for full BESS manufacturing and a mandate for domestic content in large tenders** — fostering supply-chain resilience and driving down costs through indigenous production. Local BESS manufacturing is essential for reducing India's import dependence, stabilising costs, and strengthening supply-chain resilience.

Clear customs classification, differentiated duties, and targeted incentives—along with domestic-content mandates, prioritise localising the full value chain (cells → packs → systems) and accelerating commissioning of PLI beneficiaries —will accelerate self-reliance.

India's Grid-Scale **BESS Workforce** and Training Pathways

Amit Singh
Consultant at Radical Enertech

India's energy transition hinges on renewable integration, with Battery Energy Storage Systems (BESS) emerging as a key enabler of grid stability. ***Rapid capacity growth from 0.5 GWh in 2025 to 1,840 GWh by 2047 demands millions of skilled technicians*** *across installation, operation, manufacturing, and recycling. Yet, workforce readiness remains a critical gap. This article explores India's BESS manpower needs, skill gaps, and policy pathways to build a national training ecosystem.*

The Government of India's National Electricity Plan (NEP 2023), the Optimal Generation Capacity Mix report, and MNRE's policy frameworks all point toward a rapid build-out of energy storage to match rising renewable penetration. But one crucial question remains insufficiently addressed in public policy discourse: ***Does India have the skilled workforce required to install, commission, operate, maintain, and eventually recycle the country's upcoming gigawatt-scale storage infrastructure?***

A detailed BESS manpower market analysis for grid-scale installations (2025–2047) reveals that India will require 4.5 to 10.7 million cumulative job-years of skilled manpower across EPC, O&M, factory operations, battery refurbishment, and recycling. This unprecedented workforce requirement signals both a strategic challenge and a nation-building opportunity—one that calls for institutional collaboration between private training centres and government bodies such as SCGJ, NCVET, TERI, CEA, and SECI.

1. India's Storage Build-Out: The Workforce Implications

India's grid-scale BESS capacity is projected to grow from 0.5 GWh in 2025 to 1,840 GWh by 2047, aligned with NEP 2023 and Vision 2047 storage requirements. This represents a 150-fold expansion over two decades—one of the highest projected growth rates globally.

The employment trajectory mirrors this scale-up:

Year	Total BESS FTE Requirement
2025	~7,000 FTEs (early EPC pilots)
2032	~700,000 FTEs (commercial-scale adoption)
2040	~350,000 annual FTEs (gigawatt clusters)
2047	~950,000 cumulative FTEs (maturity stage)

These numbers demonstrate that India's energy storage sector is not merely a technological market, it is a large-scale labour market that will require policy-driven skill development pathways, especially for blue-collar manpower whose roles form the backbone of actual project execution.

2. Sector-Wise Breakdown of Manpower Needs: A closer look at the job distribution reveals four major workforce clusters, each with distinct policy and training requirements:

EPC & Construction (90-95% of All Jobs): EPC accounts for the majority of manpower needs because BESS installations are field-intensive. Every megawatt-hour requires significant labour for:

- Civil works and foundations
- Rack assembly and mechanical installation
- DC wiring, harnessing, and isolations
- PCS integration and AC interconnection
- SCADA/BMS wiring and testing
- HVAC setup
- Fire suppression systems
- Pre-commissioning & QA/QC checks

These roles are labour-intensive in India due to low automation and complex multi-system coordination. The manpower requirement per MWh ranges from 2.3 to 5.6 job-years, depending on EPC cost assumptions and labour share (10–15%).

O&M (1.5-2% Long-Term Roles): As India reaches over 7,000 BESS sites by 2047, O&M becomes a steady long-term employer. Roles include:

- Shift technicians
- HV/MV electrical technicians
- HVAC technicians
- Fire safety & emergency response staff
- Spares, logistics & warehouse personnel
- Field service technicians

These jobs require NSQF-aligned skill levels and adherence to CEA grid safety regulations.

Manufacturing & Gigafactories: Under India's ACC-PLI initiative, gigafactories with 20–70 GWh capacity will generate:

- 10,000+ manufacturing jobs per line
- Primarily in cell assembly, formation, quality control, system integration, and plant maintenance

Battery Refurbishment & Recycling: Post-2031, as early battery assets retire, India will need trained manpower for:

- Dismantling
- Safe cell/module separation
- Chemical treatment
- Recycling operations

This segment alone is projected to add 6,000+ jobs annually, growing as circular-economy infrastructure scales up.

3. Why BESS Demands New Technical Skill Standards: Unlike solar or conventional electrical work, BESS installations involve complex multi-disciplinary interfaces:

- Electrical + mechanical + thermal systems
- Power electronics integration
- High-voltage switching and safety
- SCADA & BMS communication protocols
- Fire safety in lithium-ion systems
- Hazardous material handling
- Cybersecurity considerations

Traditional ITI-level training does not cover these competencies. The absence of formal Qualification Packs (QPs) for BESS technicians creates a vacuum, leading to inconsistent skill standards across states and contractors.

For India to deploy BESS at scale, policy frameworks must institutionalise standardised skill sets across blue-collar job roles.

4. Job Role Architecture as a Policy Input for QP Development: A national BESS skilling ecosystem requires a structured job-role architecture.

EPC Technician Job Roles (9):

- Civil works assistant
- Mechanical assembler
- Battery rack installer
- DC wiring technician
- HV electrician
- PCS/AC-side technician
- SCADA/BMS wiring technician
- HVAC & fire suppression specialist
- Testing & commissioning technician

Each job role must include NSQF level assignment, competency standards, and safety norms.

O&M Technician Job Roles (6):

- Shift O&M technician
- HV/MV electrical technician
- HVAC technician
- Fire safety technician
- Warehouse & spares technician
- Field service technician

These **15 roles** collectively form the baseline framework for QP development.

5. The Economic Case for National BESS Skilling: Manpower forms a significant share of EPC cost. Labour intensity in India is driven by:

- Low automation on sites
- High manual QA/QC requirements
- Terrain variations across states
- Higher proportion of distributed electrical tasks

This creates a predictable, recurring labour demand that can be systematically addressed through national training policies. BESS workforce development contributes to Job creation in rural & semi-urban areas, enhanced grid reliability, faster RE integration, reduction in project delays, improved safety standards and support for Make-in-India manufacturing.

6. The Case for Private Training Centres as Skill Delivery Partners

Government skilling bodies (SCGJ, NCVET, NISE, NSDC) provide frameworks, but they do not operate a large-scale, hands-on training infrastructure. Given India's target of training 50,000–80,000 BESS technicians annually, private training institutes must become implementation partners. Key strengths of private centres include:

- Lab Infra – Battery racks, PCS units, HVAC demos, fire suppression systems, SCADA simulators.
- Modular Training – Short-term (2–6 week) practical programmes aligned with industry demand.
- Geographical Reach – Centres can be deployed in RE-dense regions like Gujarat, Rajasthan, Maharashtra, Karnataka, and Tamil Nadu.
- Industry Linkages – Placement pipelines with EPC contractors, OEMs, and integrators.
- Agility – Faster curriculum updates aligned with technology evolution.
- A policy ecosystem must therefore incentivize private participation through accreditation, subsidies, CSR partnerships, and industry-recognised certification.

7. SCGJ, TERI, NCVET: Institutional Anchors for a National Training Mission

SCGJ (Skill Council for Green Jobs) - Responsible for drafting QPs, NOS (National Occupational Standards), and certifying training providers.

NCVET (National Council for Vocational Education & Training) – Approves QPs, accredits training partners, and ensures national qualification alignment.

TERI (The Energy and Resources Institute) - Provides technical expertise in energy systems, safety, materials, and policy linkages.

Together, these institutions should co-create National BESS Qualification Packs, Standardized curriculum frameworks, Trainer-certification programmes, Lab infrastructure specifications amd Safety compliance modules aligned with CEA regulations. This collaboration ensures uniformity, scalability, and industry acceptance.

8. Manufacturing & Recycling: Emerging Skill Priorities

As India advances its cell manufacturing capacity under ACC-PLI and develops recycling hubs, new skill categories emerge:

- Electrode preparation technicians
- Cell assembly line operators
- Formation and testing staff
- Automation & robotics technicians
- Chemical recycling operators
- Hazardous waste handlers

These roles require new QPs under NCVET, incorporating EHS norms, thermal runaway mitigation, and chemical safety protocols. Private institutes can partner with gigafactories for hands-on apprentice programmes linked to government schemes.

9. Regional Skill Clusters: Aligning Workforce Supply with Demand

India's BESS workforce demand is geographically uneven. High-priority regions include:

- Gujarat: Dholera, Mundra—manufacturing + grid storage
- Rajasthan: Jaisalmer, Bikaner—large solar + storage EPC clusters
- Maharashtra: Pune, Mumbai—system integration hubs
- Tamil Nadu: Mannar, Chennai—manufacturing + recycling
- Telangana: Emerging EV battery production zone

Policy makers must encourage training centres in these corridors to supply manpower to nearby projects, enhancing placement outcomes.

10. Workforce Hiring Structure: Policy Implications

India's BESS hiring follows a hybrid model:

Sector	Hiring Model	Implication
EPC	70–80% outsourced manpower	Need for short-cycle training + contractor accreditation
Gigafactories	60–70% direct employees	Need long-duration vocational programmes
Recycling	40–50% outsourced	Need strict safety & hazardous material handling QPs

Training policies must account for these divergent demand types.

11. Toward a National BESS Skills Mission

A comprehensive National BESS Skills Mission should integrate:

- Government Bodies – MNRE, SCGJ, NCVET, CEA, NSDC, SECI
- Academic & Technical Institutions – TERI, NISE, IITs, polytechnics
- Industry Stakeholders – EPC players, OEMs, gigafactories, recycling plants
- Training Providers – Private skill centres with accredited labs

The mission should target:

- 50,000 certified BESS technicians annually by 2032
- One accredited BESS training lab per RE-dense district
- National QPs for 15 job roles
- Mandatory certification for EPC technicians
- Integration with CSR funding for skill expansion

Conclusion

Building India’s Energy Storage Workforce for 2047 – The grid-scale BESS segment represents one of India’s most significant clean-energy job engines. With 10 million job-years of projected manpower demand, the storage sector requires urgent, coordinated action to build a national training ecosystem.

By creating standardised Qualification Packs, certifying private training centres, aligning industry and government curricula, and expanding hands-on lab infrastructure, India can ensure a high-quality workforce ready to build and sustain its energy storage infrastructure.

A robust BESS training ecosystem is not merely a labour initiative, it is a critical enabler of India’s renewable energy future, grid stability, and long-term economic competitiveness.

This article is authored by Amit Singh, Consultant at Radical Enertech, a firm specialising in clean-energy solutions including BESS, EV infrastructure, and solar PV.

INSIGHT

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ADB Approves **$650M Loan** to Scale Rooftop Solar for 10 Million Indian Households

The Asian Development Bank (**ADB**) has approved a **$650 million** policy-based loan to support India's rooftop solar expansion, aiming to provide clean, affordable energy to **10 million households** by 2027 under the **Pradhan Mantri Surya Ghar: Muft Bijli Yojana** (**PMSGMBY**).

The program offers **residential subsidies of 60% for systems up to 2 kW and 40% for additional capacity up to 3 kW,** while promoting low-interest, collateral-free loans, standardised guidelines, and quality standards to accelerate adoption.

The initiative is expected to install **30 GW of rooftop solar,** reduce 28.8 million tons of CO_2 annually, create green jobs, and enhance gender-inclusive capacity building for at least 5,000 personnel. ADB's $3 million in technical assistance will support reforms, institutional capacity building, and private-sector engagement, fostering a robust ecosystem for manufacturers, vendors, and service providers across India's renewable energy sector.

Octillion Initiates Solar-Enabled Operations at its Pune Battery Facility

Octillion has converted its **Pune EV battery manufacturing factory to run entirely on solar power,** making it the first of its India-based facilities to achieve full solar operation. The 8,200 m^2 factory produces 3 GWh of battery capacity annually, and its **rooftop solar system now generates approximately 545 MWh per year, covering all of the facility's energy needs.** The solar conversion began in June 2024 and reached full operation in July 2025.

Paul Beach, Global President, highlighted that converting the Pune factory to full solar operation closes the loop by producing clean energy storage solutions with clean energy today, **marking the first step toward carbon-neutral operations across all India facilities by 2027.**

Nikhil Parchure, Senior Vice President, noted that **Octillion's three large-scale Indian factories—two in Pune and one in Gujarat**—enable the company to efficiently meet the growing needs of the EV sector while minimising environmental impact. He added that Octillion has built a robust national supply chain over the last decade and will continue advancing safe, cutting-edge battery systems to support cleaner, more efficient transportation in India and globally.

Waaree Energy Storage Solutions has raised **₹1,003 crore** from strategic investors, including family offices, HNIs, and institutions. The funds support a **₹10,000-crore** capex plan to set up a 20 GWh lithium-ion cell and battery pack manufacturing plant.).

Waaree Energies also received an order to supply **1,500 MW** of solar modules; **1,000 MW** under DCR and 500 MW under Non-DCR. The order is from a power generation, transmission, and distribution company and will be fulfilled as per the agreement.

ACME Solar Holdings secured **INR 4,725 crore** in debt from Indian financial institutions for renewable energy project financing and refinancing, with 18–20-year tenors. The funding covers greenfield projects, operational project refinancing, and expansion of non-fund based banking limits.

NLC India Renewables (NIRL) signed a long-term PPA with SJVN for a 200 MW wind project under SJVN's **600 MW** ISTS-connected Wind-2 Tranche. The project will generate **~500 million** units annually and connect via the interstate transmission system.

ReNew Energy signed a long-term agreement with **Google** for a 150 MW solar project in Rajasthan, with Google procuring its energy attributes. The project, commissioning in 2026, will generate ~**425,000 MWh** annually, raising ReNew's C&I portfolio to **2.7 GW.**

Attero is investing **~INR 150 crore** to expand its e-waste network with three new plants in Pune, Bengaluru, and Faridabad, adding 75,000 tonnes/year capacity. A new copper plant in Reengus, Rajasthan and R&D in Greater Noida raise total processing capacity to 244,000 tonnes/year.

Suzlon and **Yanara** signed two new **153 MW** wind contracts for FDRE projects in Barmer, Rajasthan. Suzlon will install 102 × 3 MW turbines across the 306 MW projects, supplying power to NTPC and NHPC.

Premier Energies secured **₹2,307.30 crore** in new orders during Q3 FY26, to be executed in FY27–FY28. The orders, from domestic IPPs and other clients, support the company's plans to expand to 10.6 GW of solar cell and 11.1 GW of module capacity by September 2026.

RenewSys India has signed a supply agreement with **Icon Solar-En Power** to provide **300 MW** of POE encapsulants for solar modules from January to April 2026. The deal supports large-scale solar manufacturing and the adoption of advanced encapsulant materials in India.

1- **Inox Clean Energy** and its subsidiary Inox Solar have raised **₹3,100 crore** in an equity round at a pre-money valuation of ₹50,000 crore. The round saw participation from CalPERS, SUN Group Global, Authum Investments, Akash Bhansali, and other HNIs.

2- **Inox Clean Energy's** IPP arm, Inox Neo Energies, has acquired **250 MWp** of operational solar projects from SunSource Energy, with ~50 MWp more under acquisition. The projects span 13 states and supply power to C&I customers under long-term agreements.

3- **Inox Clean Energy** is acquiring Vibrant Energy, a 1,337 MW renewable portfolio with 800 MW operational, from Macquarie and other shareholders. The projects span MP, Maharashtra, Karnataka, Telangana, and Andhra Pradesh, strengthening Inox's renewable generation and solar manufacturing platform.

4- **INOXGFL Group** expands in solar and wind manufacturing with a **3 GW N-type** TOPCon solar module facility and a 1.2 GW wind nacelle and hub plant. The facilities support renewable energy production and improve logistical access across western and southern India.

1- **Juniper Green Energy** has raised **₹2,039 crore** in debt from **NaBFID, HSBC, DBS Bank India, Barclays, and Aseem Infrastructure Finance.** The funds will support wind and solar-wind hybrid projects in Gujarat and Maharashtra, along with under-construction renewable assets.

2- **Juniper Green Energy** has commissioned 60 MWh of its 100 MWh BESS project in Bikaner, Rajasthan, with the remaining 40 MWh coming soon. The company is also installing 400 MWh of BESS at Fatehgarh, Rajasthan, set for Q1 2026 commissioning.

Leapting has secured a **1+ GW order for solar cleaning robots from ReNew Power** for two utility-scale projects: 609 MWp in Andhra Pradesh and 420 MWp in Rajasthan, using single-axis trackers and LEAPTING G1 robots.

GREW Solar has secured a **1,464 MW solar PV module supply** order from NTPC Renewable Energy for projects in India. The order leverages GREW's automated manufacturing setup with stage-wise quality checks and defined processes.

VIKRAN Engineering received a **₹2,035.26 crore** order from Onix Renewable for 600 MW AC solar projects across Maharashtra. The turnkey EPC contract covers design, supply, installation, and commissioning, to be completed in 12 months.

VIKRAN Engineering has also received an EPC contract worth **₹459.20 crore** from NTPC Renewable Energy for a 400 MW AC solar project at Chitrakoot-1, Uttar Pradesh. The 12-month contract covers the Balance of System, including installation, testing, commissioning, and guarantees.

Purvah Green won a Letter of Award from **REMCL** to set up a **180 MW** grid-connected renewable project with storage, supplying round-the-clock power to Indian Railways. The company was selected in REMCL's 1,000 MW RTC tender at a tariff of ₹4.35 per unit.

CEIGALL India received a ₹550 crore EPC award from MP Urja Vikas Nigam to set up 130 MW (AC) grid-connected solar PV plants under PM KUSUM-C in Madhya Pradesh. The 18-month project includes 25 years of operation and maintenance.

POWERCON® has secured a 10-year O&M contract from REMCL for its 26 MW wind project in Dangri, Jaisalmer, covering 13 Inox 2 MW turbines. Phase 1 involves diagnostics and remediation, while Phase 2 ensures long-term operation, reliability, and asset life over the 10-year term.

ArcelorMittal announced three renewable projects in India totalling **1 GW** of solar and wind capacity at Amaravati, Bikaner, and Bachau, Gujarat, with combined CO_2 savings of ~1.59 million tonnes. The $0.9 billion projects will supply power to AMNS India, **its 60/40 JV with Nippon Steel,** alongside a 550 MW Bachau project, saving 0.9 million tonnes of CO_2.

1- **Tata Power Renewable Energy** and **UCO Bank** have teamed up to offer rooftop solar loans for Indian households. Customers can get loans up to ₹2 lakh at a 6% reducing interest rate, with flexible financing options covering 80% of systems costing ₹2–6 lakh.

2- **Tata Power Renewable Energy** commissioned a **1 GW** DCR solar project in Bikaner, supplying 1 GW to RUVITL, JKPL, and UPCL and offsetting 1.74 million tonnes of CO_2. TPREL's total utility-scale renewable capacity now reaches 11.6 GW, including 5.8 GW operational and 5.8 GW under implementation.

3- **Tata Group** plans EV manufacturing expansion in Uttar Pradesh, including new models, electric buses, and ecosystem development.

Orient Green Power, through its subsidiary DELTA, has commissioned a 7 MW AC solar project at Krishnasamudhram Village, Tiruttani Taluk, Tiruvallur District, Tamil Nadu.

Deendayal Port Authority has awarded **TuTr Hyperloop Pvt. Ltd.** a work order to demonstrate Linear Induction Motor (LIM)-based mobility technology. The project will be executed in three phases: sub-scale LIM pod testing, maglev system demonstration, and a full-scale cargo corridor showcase at the port.

Lineage Power Pvt. Ltd., a subsidiary of **Pace Digitek,** has secured an order worth ₹997.1 million from Advait Greenergy. The project bolsters India's energy storage and grid stability efforts while enhancing Pace Group's presence in telecom and renewable power management.

TPG and MAVCO have acquired **Siemens Gamesa's onshore wind business in India and Sri Lanka**, forming Vayona Energy. The company, a wind turbine OEM with around 1,000 employees, manages over 12 GW of assets, with Vellayan Subbiah as Chairman and Prashant Jain as Executive Vice Chairman.

Apraava Energy has raised **INR 8,009 million** from British International Investment and Standard Chartered to expand its AMI infrastructure. The funds will support the deployment of over two million smart meters under India's RDSS programme, enhancing renewable integration, reducing losses, and improving grid efficiency.

INA Solar (Insolation Energy) secured **solar PV module orders worth INR 516.05 crore**, including INR 357 crore for N-Type TOPCon modules to an IPP and INR 159.05 crore for PM-KUSUM projects in Andhra Pradesh. The company also received LoIs for 226.45 MW of Rajasthan solar projects and reported H1 FY26 revenue of INR 776.7 crore, up 25.6% YoY.

1- **KPI Green Energy Ltd.** (KP Group) has received a work order from Gujarat State Electricity Co. Ltd. to execute a 142 MW (DC) / 110 MW (AC) floating solar project at Kadana Dam, Gujarat. The EPC project includes grid connection and a 10-year O&M contract, with completion targeted in 18 months.

2- **KPI Green Energy** has started power generation from its 92.15 MWp IPP hybrid project awarded by GUVNL, ahead of the July 2026 schedule. The project comprises 16.95 MW of wind and 75.2 MWp of solar capacity, with power supplied to GUVNL under a long-term PPA.

3- **KPI Green Energy** has received charging approval for 32.4 MW of solar and hybrid projects under its CPP segment. The projects were developed for clients of KPI Green Energy and its subsidiary Sun Drops Energia, with approvals in the clients' names.

4- **KP Group** signed an MoU with the Botswana government to develop renewable energy, storage, and transmission projects worth $4 billion, boosting capacity to nearly 5 GW. KP Group will handle project development end-to-end and provide 30 annual scholarships for Botswana citizens.

Websol Energy System Ltd. has signed an MoU with **Linton Crystal Technologies** to explore PV ingot and wafer manufacturing in India. Linton will supply equipment and technical expertise, supporting Websol's team training and advancing India's domestic solar manufacturing capacity.

1- **Sterling and Wilson Renewable Energy (SWREL)** has secured its first order under a 5-year partnership with Adani Green Energy for a 1 GW solar project at Khavda, Gujarat. The Balance of System (BOS) package is valued at ~₹1,381 crore (excl. taxes).

2- **Sterling and Wilson Renewable Energy (SWREL)** also secured a 240 MW AC solar PV EPC project in South Africa worth ~USD 147 million (~INR 1,313 crore).The company now has four ongoing South African solar projects, with total EPC orders this fiscal exceeding ~INR 5,088 crore.

Roofsol Energy signed a 500 kWp rooftop solar PPA with Nidec India in Ranipet, Tamil Nadu. The project will generate 7.5 lakh units of green electricity annually, cutting 620 tonnes of CO_2 emissions.

Vikram Solar commissioned a 5 GW solar module facility in Vallam, Tamil Nadu, raising its total capacity to 9.5 GW. The TOPCon plant supports M10, G12, and G12R formats with automated production and quality systems.

INOX Air Products has signed a long-term deal to supply ultra-high purity nitrogen to ReNew's TOPCON solar cell facility in Dholera, Gujarat. An Air Separation Unit will be set up on-site.

AMPIN Energy Transition Pvt. Ltd. has secured a **USD 50 million** investment from FMO, which will support greenfield renewable energy projects in India and help advance the nation's goal of achieving 500 GW of non-fossil fuel energy capacity by 2030.

Adani Green Energy Twenty Five B Ltd. has signed agreements with Asahi India Glass for 20.8 MW of solar-wind hybrid power. The power will be supplied from solar and wind plants at Khavda, Gujarat.

Power Mech Projects, through PM Green Energy, has won a 250 MW / 1000 MWh BESS project from the Government of West Bengal, with a greenshoe option for an additional 250 MW / 1000 MWh. This marks Power Mech's entry into energy storage and supports grid stability amid India's renewable energy expansion.

AM Green Group and **Mitsui** signed an MoU to explore collaboration and investment in low-carbon aluminium. AM Green Metals is building a 1 MTPA aluminium smelter and 2 MTPA alumina refinery in Andhra Pradesh, powered by renewables, with Mitsui potentially providing equity and offtake support.

Freyr Energy Services has launched **self-cleaning hybrid solar systems** for residential customers, reducing dust-related power loss and maintenance. The systems combine grid-connected solar with battery storage, supported by central and state subsidies.

Luminous Power Technologies secured a 350 MW solar project under PM-KUSUM in Rajasthan, using 1,000 NXI A on-grid inverters. The project aims to boost farmers' income, support grid stability, and reduce emissions with scalable solar solutions.

Bondada Engineering received a **₹945.10 crore LoA from NLC India** for Balance of System works on the 810 MW RVUNL Solar Park in Bikaner, Rajasthan. The 15-month project covers design, supply, installation, commissioning, evacuation, and three years of O&M.

Mindra New Energy and **REPT BATTERO Energy** have signed an MoU for a 1 GWh partnership in India. Mindra will distribute 150 MWh of battery packs, source 850 MWh of lithium-ion cells, and set up a 1 GWh battery assembly line over 1.5 years for EV and energy storage applications.

NavPrakriti Green Energies plans to partner with 150+ battery companies and OEMs over three years to build a lithium-ion battery collection, recycling, and refurbishment network in India. The company has also launched Eastern India's first lithium-ion battery recycling facility.

Jakson Green placed a repeat 100 MW order with **Inox Wind** for 3.3 MW turbines in Gujarat, part of a total FY26 order inflow of ~600 MW. The contract includes limited EPC and multi-year O&M services under a 2.5 GW framework agreement over three years.

ABREL EPC Ltd., a subsidiary of **Aditya Birla Renewables,** has placed a 102.3 MW order with Inox Wind for 3.3 MW turbines for projects in Karnataka.

Naxion Energy has launched Coimbatore-made Sodium-ion energy storage systems (3.5 kW, 5 kW, 10 kW) with integrated battery, inverter, and solar MPPT, offering high-rate charging/discharging for backup power. The company plans a localized Sodium-ion battery ecosystem in India to cut imports and boost energy security.