MINCHU Newsletter

Department of Electrical & Electronics Engineering

Volume 13 | Issue 1 | JUNE 2026

Vision and Mission of the Institute

Vision

- To be one of the premier institutions of Engineering and Management education through excellence in academics, research, innovation and entrepreneurship with global standards.

Mission

- To impart world class value-based education in Engineering and Management.
- To provide thrust for research activities by establishing centres of excellence in sustainable innovative technologies and collaborate with industries to carry out interdisciplinary research.
- To generate highly skilled and competent manpower with leadership qualities, team spirit and concern for society and environment.
- To nurture organizational culture conducive for faculty to be competent and set higher standards.

Vision and Mission of the Department

Vision

- To be a renowned department in Electrical and Electronics Engineering through excellence in academics by promoting sustainability, technological innovations and entrepreneurship.

Mission

- To provide high-quality technical education in Electrical and Electronics Engineering, fostering innovation and a commitment to lifelong learning.
- To conduct interdisciplinary research in sustainable technologies through collaborations with industry and centers of excellence.
- To cultivate teamwork and leadership qualities, empowering students to excel as successful professionals or entrepreneurs.

Program Educational Objectives (PEOs)

After two/three years of graduation, the graduates will have the ability to:

· Design and develop sustainable solutions to real-world problems through research and innovation, either as a professional or an entrepreneur.

· Adapt to technological advancements through lifelong learning to achieve organizational goals.

· Demonstrate leadership qualities and social responsibility to effectively lead and manage diverse teams and projects.

CONTENTS

James Clerk Maxwell is the Scottish visionary who revolutionized physics by formulating Maxwell's Equations, the mathematical foundation of all Electrical Engineering.

By unifying electricity, magnetism, and light into a single electromagnetic field theory, he paved the way for the invention of radio, television, and telecommunications. Often cited as the bridge between Newton and Einstein, his work transformed the world from one of mechanical components to a globally connected era of electronics and information technology.

B. N. M. Institute of Technology

An Autonomous Institution under VTU. Approved by AICTE.

Post box No 7087, 27th Cross, 12th MAIN, Banashankari II Stage, Bengaluru-560070, INDIA

Ph: 91-80-26711780/81/82 Email principal(@bnmit.in, www.bnmit.org

EDITOR'S DESK

Hello Readers!

It gives us immense pleasure to welcome you to this edition of Minchu, the biannual magazine of the Department of Electrical and Electronics Engineering, BNMIT. True to its name, Minchu—meaning spark in Kannada—represents the spark of curiosity, creativity, innovation, and passion that continues to energize our department and its students.

More than just a magazine, Minchu is a reflection of the vibrant spirit of our EEE family. Within these pages, you will find a blend of technical insights, creative expressions, student achievements, memorable events, and inspiring ideas that capture the essence of life beyond classrooms and laboratories.

Every article, achievement, and contribution featured here tells a story—of learning, teamwork, perseverance, and growth. It is a platform where budding engineers not only showcase their technical knowledge, but also express their imagination, perspectives, and individuality.

As you turn these pages, we hope Minchu informs, inspires, and ignites new thoughts in every reader. After all, every great innovation begins with a spark.

Happy Reading!

– Minchu Editorial Team

ABOUT THE DEPARTMENT

Ever since its inception in the year 2002, the Electrical and Electronics Department of BNMIT has got name in the state. The Department of Electrical and Electronics Engineering offers an Undergraduate Program in Electrical and Electronics Engineering, M.Sc. (Engineering) by Research and Doctoral degree. The faculty of Electrical and Electronics Engineering are highly acclaimed individuals with the skill set, covering wide areas of industrial and applied research. They ensure that the courses foster deeper learning and increased engagement amongst the students. Such commitment from our fraternity not only gives our graduates an edge in deciding which career path is right for them but also guarantees that by the time they graduate, they will have hands on, real-world experience in Electrical and Electronics Engineering. The students are highly motivated by the project funding provided by the New Gen IEDC from the Department of Science and Technology, Govt. of India. Industrial personnel are frequently invited by the department to train the students with the latest skillset. The Department of EEE has been accredited by the National Board of Accreditation (NBA) which is an additional feather on its crown

DEPARTMENT ACTIVITIES

Memorandum of Understanding with MEW Technology Bengaluru on 22/06/2026

Memorandum of Understanding with M/s NexGen Engineering Pvt. Ltd., Bengaluru on 31/01/2026

Memorandum of Understanding with M/s Mecwin, Bengaluru on 18/02/2026

Beam-Build-Battle –organized by Synergy Club and BNMIT IEEE Power and Energy Society student chapter on 10th March 2026 - A Workshop and a competition to deploy a functional IR- Based Laser Tag system

FDP on PLC, HMI and Industrial Automation Technology from 6 th to 11 th April 2026

In Association with ISTE organized a Technical Talk on “AI-Enhanced Learning of Maxwells Equations &
Electromagnetic Waves” on 25th May 2026

Organized an engaging Activity-Based Workshop on “AI for Social Good & Sustainable Futures” on 3rd
February 2026

A Talk on ‘Roadmap to IITs and PSU Jobs through GATE’ organized by BNMIT IEEE Power and Energy Society (PES) and IEEE Vehicular Technology Society (VTS) Student Chapters on 8th January 2026 for 6th Semester EEE Students of 2023-2027 Batch

Industrial Visit to Hydro Electric Project, Poringalkuthu, Kerala to 6 th Semester students on 4 th February 2026

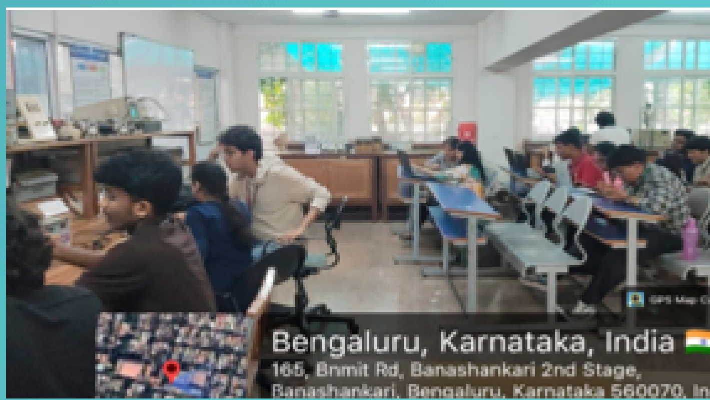
Industrial Visit to IIM, Bengaluru to 4 th Semester students on 24 th February 2026

Organized an Ideathon "VISIOn X90th under SYNERGY CLUB in Association with IIC BNMIT on 10th March 2026

Workshop on 'Design, Build and Control of Point of Load Converters: A Practical Workshop' organized by BNMIT IEEE Power and Energy Society student chapter on 2nd April 2026

Smart Grid Industry Conclave organized under BNMIT IEEE Power and Energy Society (PES) student chapter on 28th March 2026 to bring together Academic Experts, Utility Leaders and Industry Professionals to discuss the rapid digitalization, standardization and evolution of Modern Power Systems

Technical talk on "The ARM Impact: The Driving Force behind Industrial and Automotive Applications" on 27th March 2026 to provide the participants with in-depth knowledge of ARM-based processor architectures and their transformative role in shaping modern industrial and automotive systems

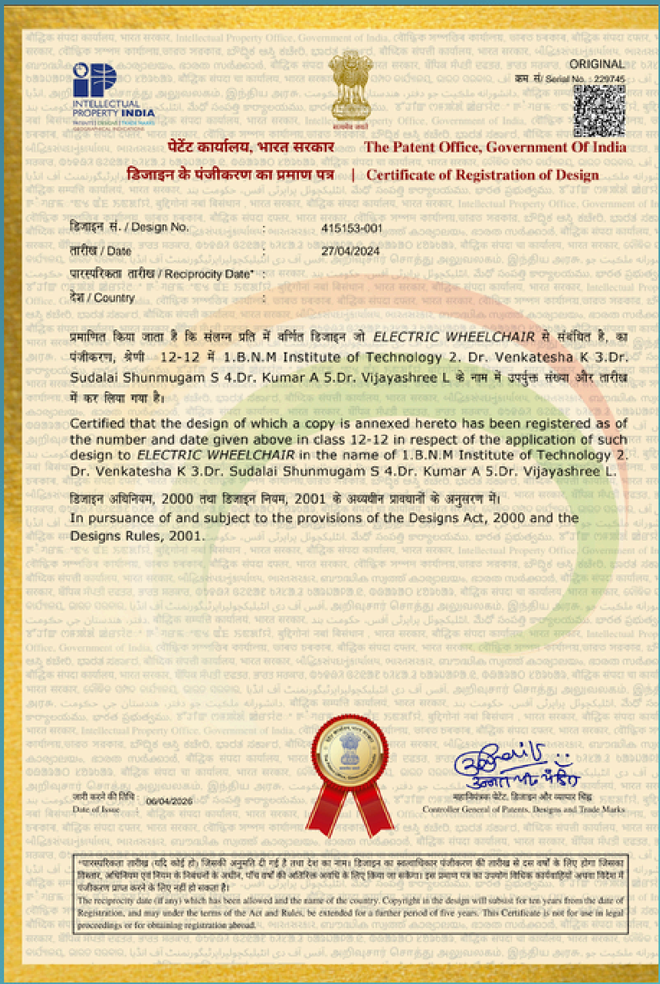


SDG ENIGMA organized by BNMIT IEEE PES Student Branch Chapter on 1st June 2026 with the objective of promoting awareness and understanding of the United Nations' 17 Sustainable Development Goals (SDGs) through engaging and interactive activities

ACHIEVEMENTS

Aditi R Prasad EEE along with the ECE department team won 3rd Place in Virtuoation 2.0 ar vr Hackathon Conducted by AIML department BNMIT.

4th sem students Samiksha and Shraddha, have won 1st place in 5 hour ideathon at KSIT


INTELLECTUAL PROPERTY INDIA

ORIGINAL

क्रम सं/ Serial No. : 229745

पेटेंट कार्यालय, भारत सरकार | The Patent Office, Government Of India

डिजाइन के पंजीकरण का प्रमाण पत्र | Certificate of Registration of Design

डिजाइन सं. / Design No.	:	415153-001
तारीख / Date	:	27/04/2024
पारस्परिकता तारीख / Reciprocity Date*	:	
देश / Country	:	

प्रमाणित किया जाता है कि संलग्न प्रति में वर्णित डिजाइन जो *ELECTRIC WHEELCHAIR* से संबंधित है, का पंजीकरण, श्रेणी 12-12 में 1.B.N.M Institute of Technology 2. Dr. Venkatesha K 3.Dr. Sudalai Shunmugam S 4.Dr. Kumar A 5.Dr. Vijayashree L के नाम में उपर्युक्त संख्या और तारीख में कर लिया गया है।

Certified that the design of which a copy is annexed hereto has been registered as of the number and date given above in class 12-12 in respect of the application of such design to *ELECTRIC WHEELCHAIR* in the name of 1.B.N.M Institute of Technology 2. Dr. Venkatesha K 3.Dr. Sudalai Shunmugam S 4.Dr. Kumar A 5.Dr. Vijayashree L.

डिजाइन अधिनियम, 2000 तथा डिजाइन नियम, 2001 के अध्यधीन प्रावधानों के अनुसरण में।

In pursuance of and subject to the provisions of the Designs Act, 2000 and the Designs Rules, 2001.

जारी करने की तिथि : 06/04/2026

Date of Issue

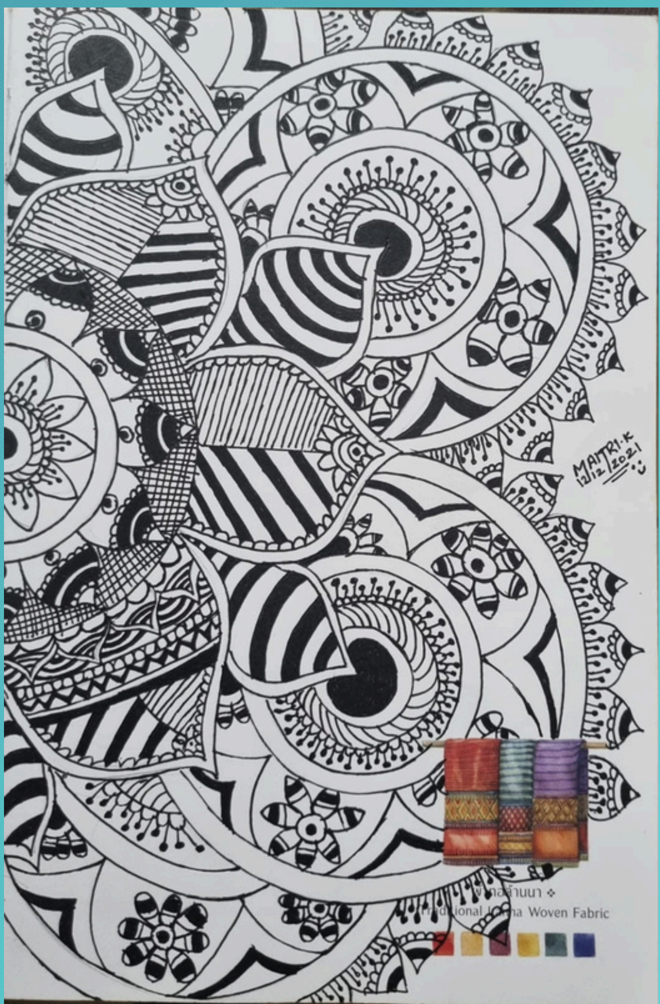
महानियंत्रक पेटेंट, डिजाइन और व्यापार चिह्न

Controller General of Patents, Designs and Trade Marks

*पारस्परिकता तारीख (यदि कोई हो) जिसकी अनुमति दी गई है तथा देश का नाम। डिजाइन का स्वत्वाधिकार पंजीकरण की तारीख से दस वर्षों के लिए होगा जिसका विस्तार, अधिनियम एवं नियम के निबंधनों के अधीन, पाँच वर्षों की अतिरिक्त अवधि के लिए किया जा सकेगा। इस प्रमाण पत्र का उपयोग विधिक कार्यवाहियों अथवा विदेश में पंजीकरण प्राप्त करने के लिए नहीं हो सकता है।

The reciprocity date (if any) which has been allowed and the name of the country. Copyright in the design will subsist for ten years from the date of Registration, and may under the terms of the Act and Rules, be extended for a further period of five years. This Certificate is not for use in legal proceedings or for obtaining registration abroad.

Patent on 'Electric Wheelchair' and registered to 'B.N.M Institute of Technology, Dr. Venkatesha K, Dr. Sudalai Shunmugam S, Dr. Kumar A, and Dr. Vijayashree L.



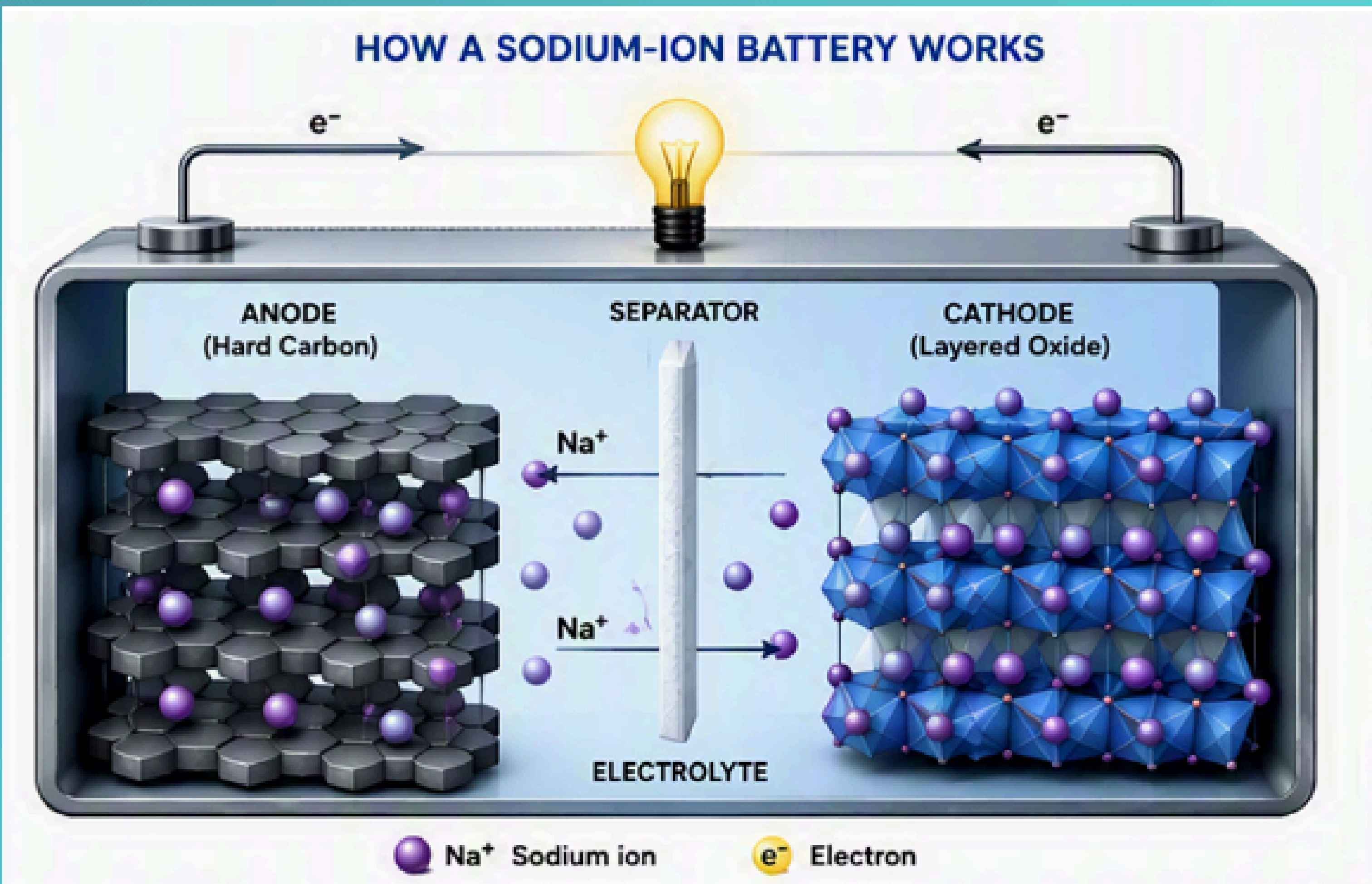
Beyond Lithium: Are Sodium-Ion Batteries the Future of Energy Storage?

As the world moves toward clean energy and electric mobility, the demand for efficient, affordable, and sustainable battery technologies is increasing rapidly. Lithium-ion batteries currently dominate the energy storage market. However, concerns related to the limited availability, rising cost, and uneven geographical distribution of lithium resources have prompted researchers to explore alternative battery technologies. Among these, sodium-ion batteries (SIBS) have emerged as a promising solution for future energy storage applications.

WHAT IS A SODIUM-ION BATTERY?

A sodium-ion battery is a rechargeable electrochemical energy storage device that operates on a principle similar to that of a lithium-ion battery. Instead of lithium ions, sodium ions (Na^+) move between the cathode and anode during charging and discharging processes.The basic components include:

- **Cathode:** Sodium-containing metal oxides or polyanionic compounds.
- **Anode:** Hard carbon, soft carbon, or other sodium-storage materials.
- **Electrolyte:** Sodium salt dissolved in an organic solvent.
- **Separator:** Prevents direct contact between electrodes while allowing ion flow.



WORKING PRINCIPLE

During charging:

• Sodium ions move from the cathode to the anode through the electrolyte.

• Electrons flow through the external circuit to maintain charge balance.

During discharging:

• Sodium ions return to the cathode.

• Electrons flow through the external load, supplying electrical energy.

This reversible ion movement enables repeated charging and discharging cycles

WHY SODIUM?

Sodium is the sixth most abundant element on Earth and is widely available in seawater and mineral deposits. Compared with lithium, sodium offers several advantages:

- Abundant and inexpensive raw material
- Reduced dependence on critical mineral supply chains
- Improved resource sustainability
- Lower environmental impact during extraction
- Better suitability for large-scale stationary energy storage systems

APPLICATIONS

Renewable Energy Storage-Stores solar and Windenergy, stabilizes power grids.

Electric Vehicles - Suitable for low-cost EVs, electric scooters, and commercial vehicles.

Grid-Level Energy Storage - Balances electricity supply and demand during peak periods.

Backup power Systems -Ideal for data telecom towers, and industries.

Rural Electrification-Supports microgrids and Off-grid Systems in remote areas.

CHALLENGES AND LIMITATIONS

Lower Energy Density: Sodium ions are larger and heavier than lithium ions, leading to lower energy density.

Limited Cycle Life: Some chemistries still have lower cycle life compared to advanced lithium-ion batteries.

Material Development: Need for new cathode/anode materials With higher capacity and stability.

Commercialization Challenges: Large-scale manufacturing infrastructure is still developing.

Future Outlook:

With continuous advancements in materials science, electrochemistry, and manufacturing processes, sodium-ion batteries are expected to become more efficient, durable, and cost-competitive. They Will complement lithium-ion batteries and play a major role in building a cleaner, greener, and more resilient energy future. As research and industrial investment continue to grow, sodium-ion batteries are poised to power the next generation of energy solutions

Dr. Shubha Rao K.
Associate Professor,
Department of Electrical and Electronics Engineering,
BNM Institute of Technology

Next-Gen Power Electronics: The Shift to GaN and SiC

Silicon's had a long run in power electronics, but it's hitting a wall. Every time it switches states, it bleeds energy as heat, and there's only so much engineering can do around that before you're just arguing with physics. That's the real backdrop to the current push toward Gallium Nitride and Silicon Carbide.

The Physical Limits of Silicon

Silicon's band gap, the energy threshold electrons need to jump before current flows, is narrow compared to these newer materials. That narrowness is exactly why silicon runs into trouble at high voltages: push it too hard and it either breaks down or wastes a large chunk of energy as heat during switching. Engineers have spent decades compensating with better heat sinks, fans, and circuit tricks, but none of that changes the underlying material limitation. GaN and SiC, by contrast, have a wide bandgap, so they can handle much higher voltages and switch far faster while shedding less energy along the way. Faster switching also means the transformers and inductors around them can shrink, since those components are sized partly around switching frequency. Smaller magnetics, less heat, less cooling hardware, it all compounds.

Material Differences Between GaN and SiC

People sometimes treat these two materials as interchangeable upgrades to silicon, but they tend to specialize. SiC handles high-voltage, high-power situations well, EV drivetrains, industrial motor drives, that sort of heavy-duty load. GaN is better suited to high-frequency, comparatively lower-voltage work, like fast chargers and data center power supplies, where switching speed matters more than raw voltage tolerance. There's also been a real architectural shift within GaN itself recently. Older "lateral" GaN designs move current across the surface of the chip, which caps how much voltage the device can safely handle. Newer "vertical" GaN designs push current through the bulk of the material instead, and that's recently gone from lab prototype to actual commercial product, letting GaN devices operate above 1200 volts, territory that used to belong to SiC exclusively. It's a meaningful blurring of the line between what each material is "supposed" to do.

Applications in Electric Vehicle Inverters

The clearest real-world payoff shows up in electric vehicles. The industry's been steadily migrating toward 800-volt battery architectures, which charge faster and lose less energy over long cable runs, but silicon inverters were never well suited to that jump. Swapping in SiC-based inverters noticeably shrinks the physical size of the onboard power electronics, freeing up space and weight that can go toward extra battery capacity or just a lighter car overall. That said, this hasn't been an even rollout. There's been chatter in the industry about SiC adoption slowing in parts of Europe, even as Chinese manufacturers keep pushing SiC-equipped platforms hard. So it's less a clean global shift and more a patchwork, shaped by regional supply chains, cost, and how EV sales themselves are doing in a given market.

Manufacturing Costs and Scalability

For years, price was the obvious objection. GaN and SiC cost meaningfully more to manufacture than silicon, which made sense for premium vehicles but was a tough sell for anything mass market. That's starting to shift, mainly because wafer sizes are growing, moving from the older 200mm standard toward 300mm, which sounds like a small manufacturing detail but actually matters a lot for cost per chip, since bigger wafers yield more usable devices per run.

I'd be cautious about claims that cost parity with silicon has been fully "solved," since that language shows up a lot in industry press releases with an obvious motive to sound optimistic. But the direction is clearly downward.

Limitations and Outstanding Challenges

None of this is as tidy as it sounds in the more promotional coverage. Substrate manufacturing for these materials is geographically concentrated, which has already tangled up with broader trade tensions. And integrating these components into existing production lines isn't a simple drop-in swap, it takes real redesign work. Silicon isn't disappearing either; it'll likely remain the sensible choice for cheaper, lower-power applications where its limitations don't really bite. But for the harder end of the spectrum, EV inverters, chargers, dense power supplies, GaN and SiC have moved from a promising alternative to something closer to the obvious default.

Shriram V
3rd SEM
EEE

Power Quality Issues and Mitigations of Electric Vehicle Chargers

As of 2025–2026, India has approximately 29,000 public EV charging stations installed across the country. Government and industry reports indicate the number is in the range of 29,151–29,277 public charging stations, reflecting rapid growth in charging infrastructure [1]. According to data cited from the Bureau of Energy Efficiency (BEE), Bengaluru has approximately 4,462 public EV charging stations within the city, while Karnataka has around 5,765–6,000+ stations statewide.

Tamil Nadu has approximately 1,500 public EV charging stations, making it one of the leading states in EV charging infrastructure development. The International Energy Agency (IEA) projects 520,000 public charging points by 2035 under current policies and up to 1.2 million public charging points by 2035 under stronger EV adoption scenarios [2].

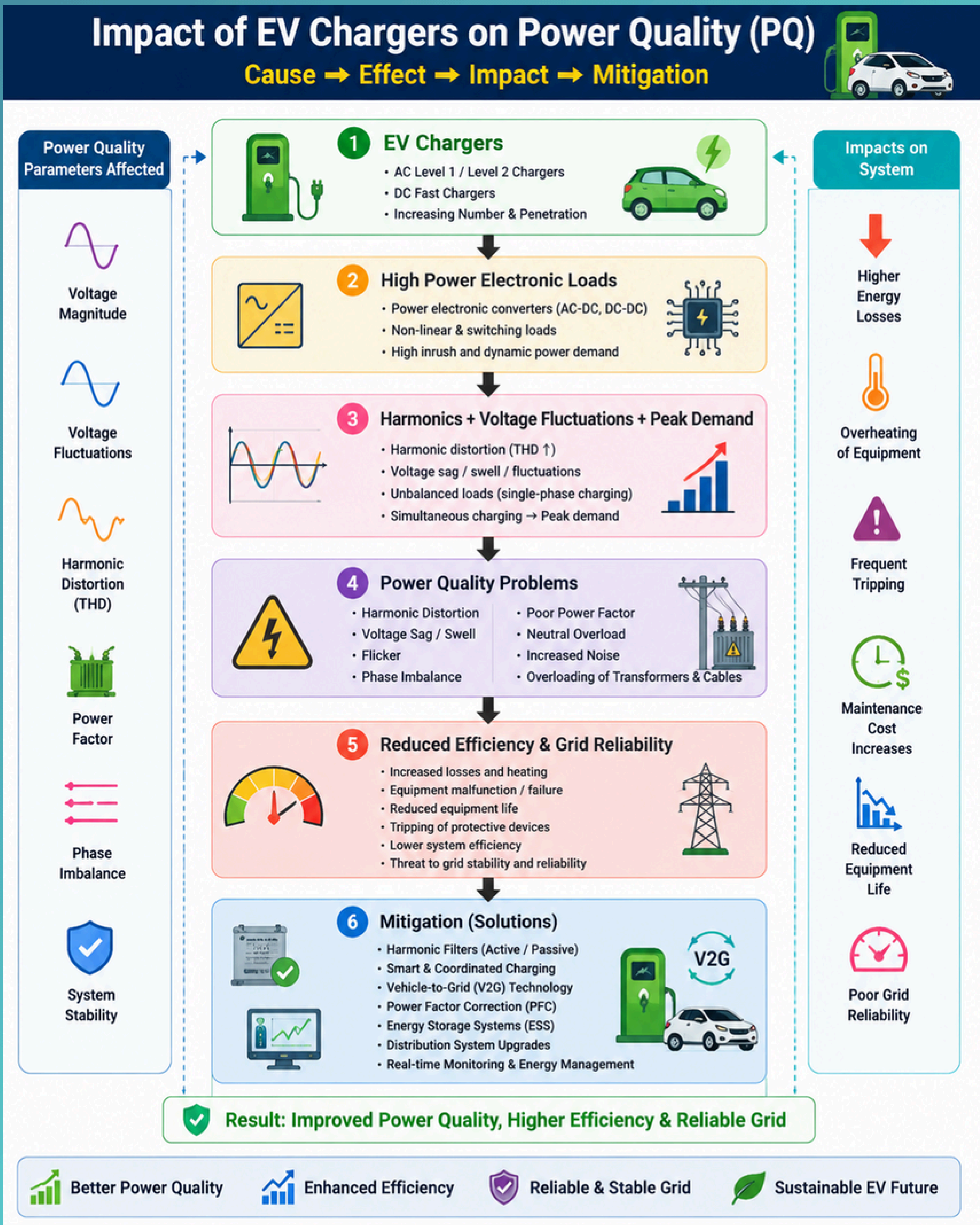
The increasing adoption of Electric Vehicle (EV) chargers can adversely affect power quality due to their high power demand and power electronic converters. EV chargers introduce harmonic distortion, voltage fluctuations, voltage sag, transformer overloading, and phase imbalance, particularly during peak charging periods. Fast chargers can also create sudden load variations, impacting voltage stability and increasing power losses. These issues may reduce equipment lifespan, lower system efficiency, and affect grid reliability. To mitigate these effects, utilities employ harmonic filters, smart charging strategies, power factor correction, demand response programs, and advanced energy management systems.

Major Power Quality Issues Caused by EV Chargers

- Harmonic distortion (high THD)
- Voltage sag and voltage fluctuations
- Increased transformer loading
- Phase imbalance
- Poor power factor
- Increased network losses
- Overheating of transformers and cables
- Reduced grid reliability

Mitigation Measures

- Active and passive harmonic filters
- Smart charging and coordinated charging
- Vehicle-to-Grid (V2G) technology
- Power factor correction
- Energy storage systems
- Distribution network upgrades



In conclusion, the widespread adoption of EV chargers presents significant power quality challenges, including harmonic distortion, voltage fluctuations, phase imbalance, and increased peak demand; however, the implementation of appropriate mitigation measures such as harmonic filtering, smart charging, power factor correction, and advanced energy management systems can ensure reliable, efficient, and sustainable grid operation.

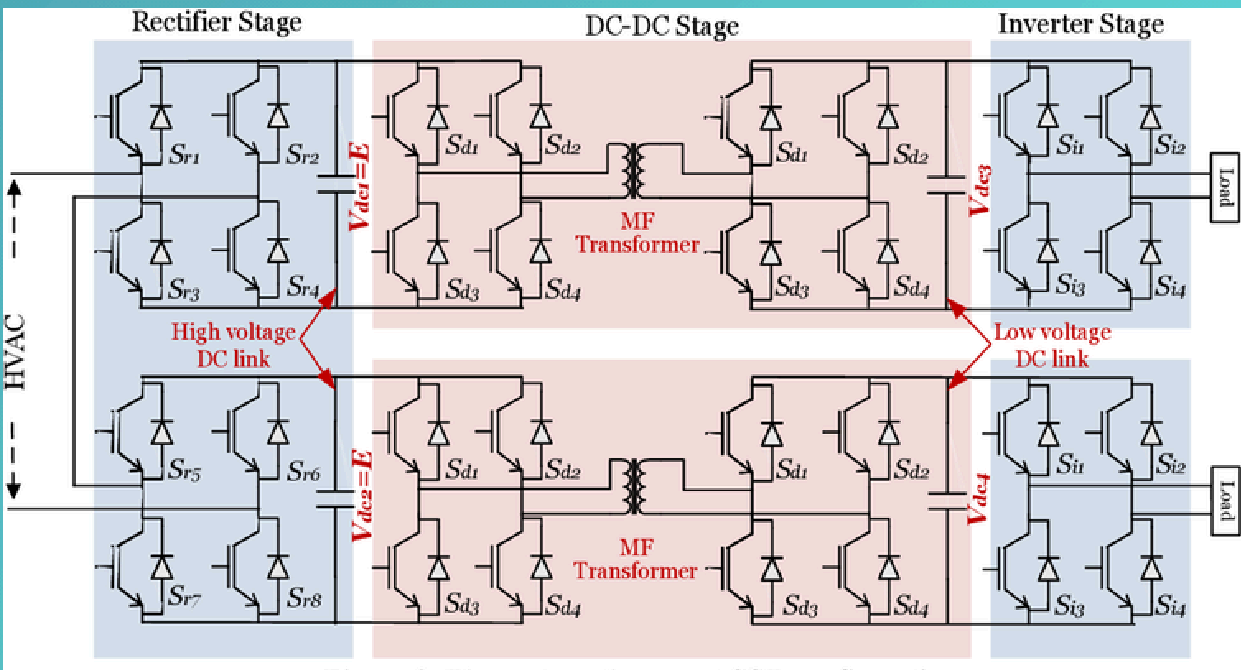
Dr.Priyashree
Associate Professor,
Department of Electrical and Electronics Engineering,
BNM Institute of Technology

Solid-State Transformers: Giving the Power Grid a Brain

We've all seen those massive, humming iron-core transformers on street corners and in substations. They've been doing the heavy lifting for our electrical grids for over a century. While they are incredibly reliable, they are also entirely passive—they essentially just sit there and step voltage up or down. But what happens when our infrastructure needs to be as smart as the devices it powers? Enter the Solid-State Transformer (SST).

How to Shrink a Transformer

Standard AC transformers and passive components are foundational to electrical engineering, but SSTs take those traditional concepts and merge them directly with modern power electronics. Instead of relying purely on a giant, heavy iron core, an SST uses an architecture of advanced semiconductor switches, like Silicon Carbide (SiC).



Here is a fun fact: the physical size of a magnetic core shrinks as its operating frequency increases. By bumping the frequency from our standard 50 Hz grid up to tens of kilohertz, an SST can be up to 70% smaller and lighter than a conventional transformer. To do this, the SST actively converts the incoming grid AC to DC, chops it up at a very high frequency, passes it through a tiny high-frequency transformer, and then converts it back.

Bringing "Code" to the Grid

The real magic is in the control. Instead of just passively letting current flow, an SST actively manages it. It's almost like taking the control flow logic used in Python or C—where the code makes real-time, conditional decisions based on inputs—and applying it to raw electrical power.

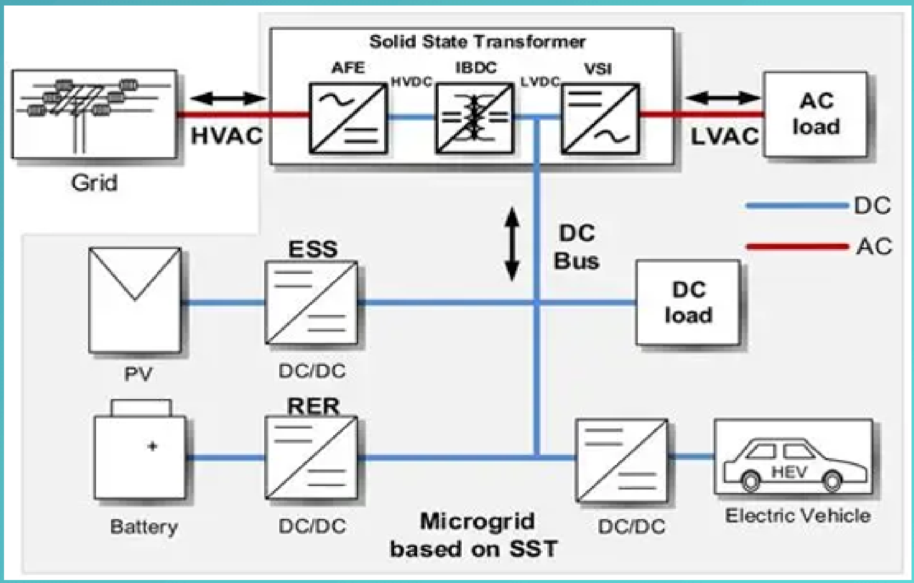
This level of active control brings several huge advantages:

- Two-way power flow: They can easily send power back and forth, which is a requirement for modern grids dealing with consumer-generated solar power.
- Built-in fault protection: They can detect short circuits and instantly cut power electronically, acting almost like a digital circuit breaker.
- Power quality correction: They actively smooth out voltage sags and filter out unwanted harmonics.

Where Do We Actually Need Them?

This level of control is exactly what the modern world demands right now:

- Hyperscale Data Centers: With the current boom in AI, data centers are drawing massive amounts of power. SSTs can feed highly efficient DC power directly to the server racks, cutting out redundant AC-DC conversion losses that waste energy and generate excess heat.
- Renewable Smart Grids: Because SSTs have native DC ports, renewable sources like solar panels and wind turbines can plug right into the grid without needing extra, bulky inverters.
- EV Fast-Charging Hubs: They easily manage high-power DC fast-charging networks for electric vehicles while balancing the local grid load.



The Road Ahead

Of course, the technology isn't perfect yet. High-power semiconductors are expensive, and figuring out how to dissipate the heat they generate is a serious engineering challenge. But as we move toward a world reliant on clean energy and heavy computing, the transformer is no longer just a passive block of iron and copper. It's becoming an intelligent, programmable hub, and that is a pretty exciting shift for the future of our field.

Shaurya P Bagi
3rd Sem
EEE

POWERING HOMES, POWERING INDIA

The Rooftop Solar Revolution — Technology, Economics, and India's Manufacturing Rise

Rooftop solar has moved from a niche, environmentally-driven choice to a mainstream engineering and financial decision for Indian households. Falling equipment costs, a strong government subsidy push, and rising electricity tariffs have together made residential solar one of the most compelling home investments available today — one with a clearly measurable payback period and a direct, quantifiable contribution to reducing the country's dependence on thermal power.

Why a Hybrid System Makes Sense

A hybrid solar system combines rooftop photovoltaic (PV) panels with battery storage and grid connectivity, rather than relying on the grid alone. Sunlight is converted to DC electricity by the panels, converted to usable AC power by a hybrid inverter, and then either used directly, stored in a battery for later use, or exported to the grid when there is a surplus. This design keeps essential home loads running during outages, reduces daytime grid dependence, and increasingly supports EV charging directly from rooftop generation — pairing two of the biggest shifts in household energy consumption into a single, self-reinforcing system.

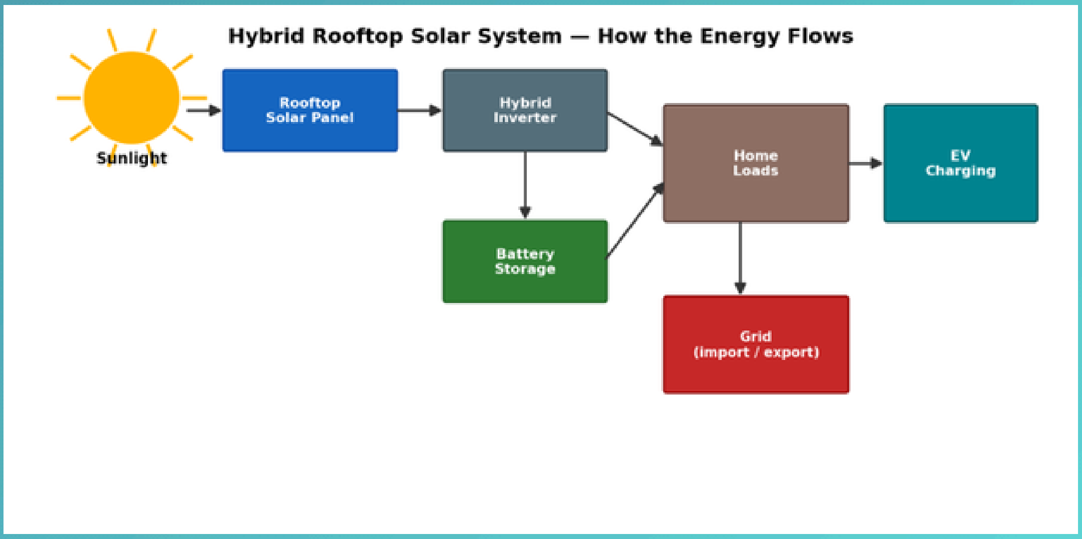


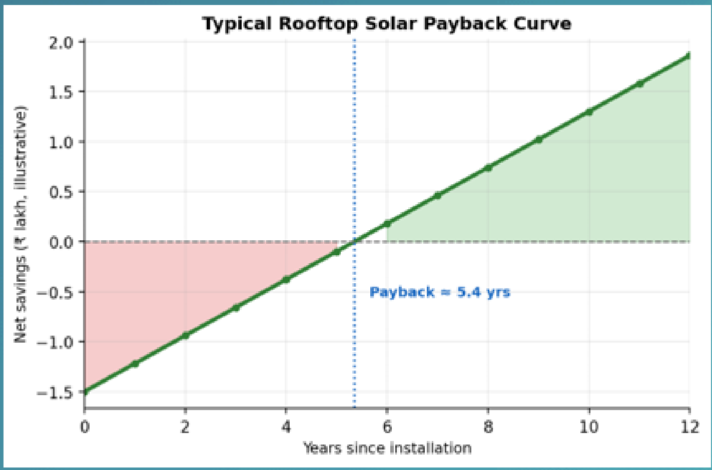
Fig. 1 — Energy flow in a typical hybrid rooftop solar system.

The Economics: What a Household Actually Saves

The financial case is what tends to convince even skeptical homeowners. A correctly sized rooftop system can offset a household's monthly electricity bill substantially, and with current subsidy support, the payback period for a typical residential installation now works out to roughly 5–6 years. After that point, the system continues generating essentially free electricity for another 15–20 years of its operating life — meaning the majority of a panel's working life is spent producing pure savings rather than recovering cost.

Government Push: PM Surya Ghar Muft Bijli Yojana

The PM Surya Ghar Muft Bijli Yojana, launched in February 2024, has been the single biggest driver of this shift. As of mid-2026, the scheme has crossed 50 lakh beneficiary households, with the pace of installation accelerating dramatically — from roughly 5,000 systems a day in October 2025 to over 16,000 a day by July 2026. Cumulative subsidy disbursement has crossed ₹22,750 crore. Notably, more than 12 lakh households have collectively earned around ₹421 crore by selling their surplus electricity back to the grid — a sign that rooftop solar is becoming a source of income, not just savings. Union Minister Pralhad Joshi has reiterated the government's ambition to put rooftop solar on every household by 2047.



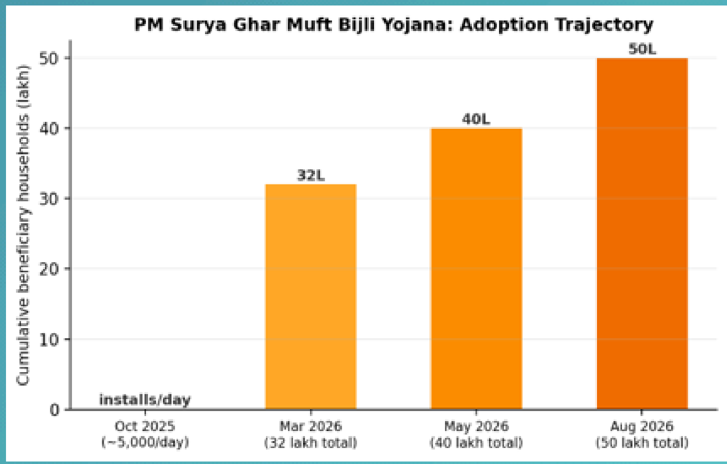


Fig. 2 -- Illustrative payback curve: cost recovered by year 5–6.

Fig. 3 --Growth in PM Surya Ghar beneficiary households.

India's Manufacturing Muscle: From Ingot to Panel

What makes this moment distinct from earlier solar pushes is that India is now building the panels, not just installing imported ones — moving up the value chain from raw silicon rather than only assembling finished modules. The manufacturing chain runs through several distinct stages:

- Ingot to wafer — purified polysilicon is melted and grown into a solid cylindrical ingot, then sliced into thin wafers, the base material for every solar cell.
- Doping — each wafer is chemically treated with elements such as boron and phosphorus to create the p-n junction, the layer structure that lets the cell generate a voltage when sunlight strikes it.
- Metallization (silver grid) — a fine silver conductive grid is screen-printed onto the wafer to collect and carry away the generated current.
- Anti-reflective coating — a thin coating reduces reflected sunlight so more light is absorbed, improving efficiency.
- PV cell — the wafer is now a functioning photovoltaic cell, capable of converting sunlight into electricity.
- Modules and arrays — individual cells are wired together and encapsulated into a module (the panel on a rooftop); multiple modules wired together form an array, the full generating unit installed on a home.

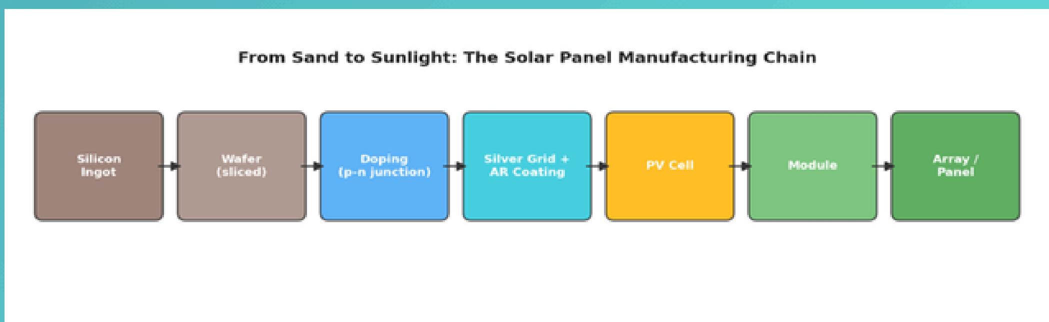


Fig. 4 — The solar manufacturing chain, from raw silicon ingot to installed panel.

Companies such as Waaree Energies, Vikram Solar, Adani Solar, and Tata Power are now investing in the upstream, capital-intensive stages of this chain — ingots, wafers, and cells — not just final module assembly. This matters because China has historically dominated the ingot and wafer stage of the global supply chain, leaving Indian manufacturers reliant on imported wafers and cells.. India's Production Linked Incentive (PLI) scheme and the Approved List of Models and Manufacturers (ALMM), which mandates domestically made cells and modules for government-linked projects, are designed to close that gap and reduce China's share of the value India captures.

Waaree Energies posted a roughly 40% five-year sales CAGR and has scaled module capacity toward 26 GW while adding cell and wafer capacity — cementing its position as India's largest solar manufacturer. As India builds this ingot-to-panel chain domestically, it ties rooftop solar directly into the country's broader semiconductor and silicon manufacturing ambitions, since both depend on the same core competency: processing ultra-pure silicon at scale.

Beyond the City: A New Income Stream for Farmers

The opportunity isn't limited to urban rooftops. Government schemes increasingly extend solar incentives to farmers, turning available land into a second, weather-independent income stream. Unlike rain-fed crop income, solar generation doesn't depend on the monsoon — giving rural households a more predictable revenue source that runs alongside, not instead of, their farming income.

A Citizen-Led Energy Transition

Large, centralized government solar plants remain essential to hitting India's 500 GW non-fossil capacity target by 2030. But distributed rooftop solar adds something governments cannot easily replicate: millions of individual household decisions, compounding through word of mouth. Every home that switches becomes a visible, local proof point for its neighbors — arguably the most effective growth channel any energy transition has ever had. As adoption scales, India moves closer to becoming a power-surplus nation capable of exporting electricity, while steadily displacing thermal generation and reducing associated carbon emissions.

Meghavarna K Mudalgiri
3rd Sem
EEE

Radar-Based Autonomous Navigation UGV in Hostile and GPS-Denied Terrains

Autonomous navigation of unmanned ground vehicles (UGVs) in defence environments remains a critical technological challenge, particularly in hostile, unstructured, and electronically contested terrains.

Current UGV navigation systems predominantly rely on optical cameras, LiDAR, and GPS, which suffer severe performance degradation under dust, fog, rain, smoke, snow, and intentional GPS jamming or spoofing—conditions commonly encountered in border areas and battlefield scenarios.

While radar technology has been extensively developed for airborne and naval platforms, its application as a primary navigation sensor for ground autonomous vehicles is still limited, especially in the Indian defence ecosystem.

Commercial UGV solutions typically treat radar as a supplementary obstacle sensor, not as the core perception and navigation modality.

This project proposes the development of a radar-centric autonomous navigation framework for UGVs, wherein a short-range navigational / imaging radar becomes the principal sensor enabling robust perception, localization, and path planning in GPS-denied and low-visibility defence environments

India currently lacks an indigenous, compact navigational radar system and associated autonomy algorithms specifically designed for UGVs to enable reliable, all-weather, GPS-independent navigation. This creates a critical capability gap for autonomous defence ground platforms operating in contested environments.

The key innovations and differentiators of the proposed system are:

- Radar-First Navigation Architecture: Radar acts as the primary perception and navigation sensor rather than a secondary aid.
- All-Weather, All-Terrain Operation: Reliable navigation in dust, fog, rain, smoke, and darkness. GPS-Independent Localization: Radar-based SLAM and odometry for operation in GPS-denied and jammed environments.
- Compact Indigenous Navigational: Radar Custom-designed short-range radar optimized for ground vehicle navigation. AI-Assisted Radar Interpretation: Machine learning models for radar feature extraction and terrain classification.
- GPS-Denied Autonomous Operation: Operates reliably in environments where GPS is unavailable, jammed, spoofed, or denied (tunnels, forests, urban canyons, battlefield EW zones, EW: Electronic Warfare).
- Radar-Centric Perception System: Uses FMCW/ mm-Wave (FMCW: (Frequency Modulated Continuous Wave) radar for navigation, obstacle detection, and terrain mapping, ensuring functionality in smoke, fog, dust, rain, and low-visibility combat conditions where cameras/LiDAR fail. Electronic Warfare (EW) Resilience: Immune to GPS jamming and spoofing attacks, making the system suitable for hostile and contested defence environments.
- All-Weather, Day-Night Capability: Radar sensing enables consistent performance irrespective of lighting or weather conditions, ensuring 24×7 mission readiness.
- Autonomous SLAM in Hostile Terrain: Implements radar-based SLAM (Simultaneous Localization and Mapping) for real-time terrain mapping and self-localization without external infrastructure.

Dr. Venkatesha K ,
Professor and Head,
Department of Electrical & Electronics Engineering,
BNMIT, Bengaluru-560070

Faculty achievements

1. Dr. Shubha Rao K has received Best Track paper award for the paper titled “Performance Evaluation of Kalman-Based Filters on 1RC and 2RC Models for Lithium-Ion Battery SoC Estimation” in second International Conference on Advances in Energy and Environmental Engineering 2026 held 0n 30-31 January 2026 hosted by Dr. Vithalrao Vikhe Patil College of Engineering, Ahilyanagar, Maharashtra.
2. Kruti Jayaram served as Resource Person for Innovation and Entrepreneurship Outreach Program in School at St. Sophia Convent High School, Nagarbhavi, Bengaluru, Organized by Department of EEE & ME in association with IIC on 30/01/2026.
3. Kruti Jayaram served as internal evaluator for Smart India Hackathon on 23/04/2026.
4. Kruti Jayaram, “ENERGY HARVESTING THROUGH FOOTSTEPS”, published in International Journal of Innovative Research in Technology, An International Open Access Journal, IJIRT.
5. Kruti Jayaram, presented paper on “Power flow control of a grid connected hybrid renewable energy system employing a multiport converter: A simulation study”, at (IECCT 2026), held on 10th and 11th April 2026, organized by the School of Electrical sciences, MVJ College of Engineering, Bangalore in Association with IEEE Bangalore Section.
6. Kruthika.M., Maitri.K., Monika.V., Radhika, Kruthi Jayaram , “ENERGY HARVESTING THROUGH FOOTSTEPS”, published in International Journal of Innovative Research in Technology, An International Open Access Journal, IJIRT (www.ijirt.org) ISSN 2349-6002 & Impact Factor 8.017, Volume 12, Issue 9, February 2026.
7. Daneshwari B Surkod, Sowmya M Kumarji, Shreya S, Kruthi Jayaram, “Vital and Environmental Monitoring using Portable MedGuard, system”, in the 14th ICCET 2026” held during 22nd & 23rd March 2026 at Prince Shri Venkateshwara Padmavathy Engineering College, Chennai, India.
8. NPTEL certification awarded to Dr.Shubha Rao K for completing the "Programming In Java" course