Anusandhan National Research Foundation

ANRF MAHA EV MISSION

Mission for Advancement in High-impact Areas (MAHA)

Program of ANUSANDHAN NATIONAL RESEARCH FOUNDATION (ANRF)

MAHA EV Mission Summit (MEMS) 2026

TECHNOLOGY COMPENDIUM

TROPICAL EV BATTERIES & BATTERY CELLS

POWER ELECTRONICS, MACHINES & DRIVES

EV CHARGING INFRASTRUCTURE

TECHNOLOGIES | SOLUTIONS | IMPACT

Curated by

- Mission PMU-PKC
- ANRF MAHA EV Mission
- Pune Knowledge Cluster Foundation
  and
- Anusandhan National Research Foundation

Contents

Overview

ANRF's programs aimed to foster a robust ecosystem of research and innovation across Indian universities, colleges, research institutions, and R&D laboratories. As the apex body for research governance in the country, in alignment with the National Education Policy, ANRF also plays a key role in building synergistic collaborations among academia, industry, government departments, and research institutions.

Mission for Advancement in High-impact Areas (MAHA) program of ANRF addresses priority-driven, solution-focused research in mission-mode that would catalyse multi-institutional, multi-disciplinary and multi-investigator collaboration to address scientific challenges and advance the frontiers of technology in key scientific areas.

The implementation of the mission mode program, Mission for Advancement in High-impact Areas (MAHA) was approved by the Executive Council (EC) of ANRF in its first meeting on August 22, 2024 to support priority-driven and solution-focused research in mission mode in one of the key sectors aligned with national priorities. Six priority areas were proposed, namely EV mobility, advanced materials, solar cells, smart infrastructure, medical devices and photonics, and EC identified EV mobility and Advanced materials among them for the year 2024-25. ANRF has identified Electric Vehicle (EV) Mobility as the first priority area of focus under MAHA program.

The first call for proposals under MAHA program was announced on E-Mobility in line with the "e-Mobility R&D roadmap for India" published by the Office of the Principal Scientific Advisor and white paper "Catalysing Technology-Led Ecosystem for e-Mobility" published by Department of Science and Technology.

The call for consortia mode proposals under MAHA EV mission was announced through ANRF online portal from October 14, 2024 to December 9, 2024 under three Technical Vertical (TV) viz. 1. Tropical EV battery and battery cells, 2. power electronics, machines and drives and 3. EV charging infrastructure. The Mission Advisory Committee (MAC) was constituted to facilitate ANRF in implementation of MAHA EV-Mission. The MAC was responsible for technical review and evaluation of proposals for financial support and also for mid-term review of sanctioned projects. The MAC was constituted by 61 experts from academic and research institutions and industry. There were 12 core members and 59 Co-opted members. Out of 59 members, 16 members were having expertise aligned with TV I, the expertise of 19 members were aligned with TV II and 24 members with TV III.

Based on the recommendations of MAC, 7 e-nodes have been established through this mission at ARCI, Hyderabad, NITK Surathkal, IIT Bombay, CSIR-CEERI, Pilani, IIT Kanpur, IIT Kharagpur and IIT BHU, Varanasi. Post-sanction governance is being ensured with the help of Mission Governing Board (MGB), which is a committee for monitoring and mentoring of seven e-nodes established under MAHA - EV Mission. As recommended by Mission Governance Board of ANRF EV-Mission, the Pune Knowledge Cluster (PKC), Pune was appointed as Mission - project management unit (M-PMU) for MAHA EV-Mission. The M-PMU will act as the central interface between the e-Node institutions (grantees) and ANRF, and will support strategic alignment, operational efficiency, governance processes, performance monitoring, and ecosystem engagement for the Mission for effective governance of e-Nodes.

Dr. T. Thangaradjou, Program Director
Dr. Anima Johari, Program Officer

E-Nodes

Institute Partners

Industry Partners

Mr. Shivkumar Kalyanaraman
Chief Executive Officer
Anusandhan National Research Foundation (ANRF)

Anusandhan National Research Foundation

India stands at a defining moment in its research and innovation journey. We have built significant scientific capability, nurtured exceptional talent, and demonstrated our ability to solve complex challenges. The next frontier is to accelerate the translation of this capability into technologies, enterprises, public systems, and societal outcomes at scale.

The Anusandhan National Research Foundation (ANRF) was created with this vision—to strengthen India's research ecosystem while fostering stronger pathways from discovery to deployment. This requires moving beyond isolated projects towards collaborative, mission-oriented programmes that bring together researchers, industry, startups, government agencies, investors, and end users around clearly articulated national priorities.

The MAHA-EV Mission embodies this philosophy.

Electric mobility represents far more than a transition in transportation. It is an opportunity to build new industrial capabilities, strengthen energy security, create high-quality employment, improve environmental sustainability, and position India as a global leader in next-generation mobility technologies. Realising this opportunity demands coordinated innovation across the entire ecosystem—from advanced materials and battery technologies to manufacturing, digital systems, recycling, standards, policy, and market adoption.

The MAHA-EV Mission has therefore been designed as a portfolio of interconnected work packages, each addressing a critical component of the innovation ecosystem while contributing to a shared national vision. Together, these work packages seek to accelerate research, enable technology development, foster industry partnerships, build institutional capacity, and generate measurable societal and economic impact.

This compendium presents the Mission's work packages and the collective ambition that binds them together. More importantly, it serves as an invitation—to ministries, state governments, research institutions, industry, startups, investors, and civil society—to participate in building an innovation ecosystem that is greater than the sum of its parts. Mission-mode programmes succeed not because individual projects excel in isolation, but because diverse stakeholders align around common goals and work together with purpose.

At ANRF, we believe that research creates its greatest value when it improves lives, strengthens national competitiveness, and expands opportunities for future generations. The MAHA-EV Mission is an important step in that direction. We hope this document provides clarity on the Mission's vision, inspires new collaborations, and catalyses collective action towards making India a global leader in electric mobility innovation.

The work ahead is ambitious, but so is the opportunity. Together, we can build an innovation ecosystem that not only advances science and technology, but also delivers enduring economic and societal impact for India.

Delhi,
25 July, 2026

Mr. Shivkumar Kalyanaraman

Mr. Karthick Athmanathan
Co-Chair, MAHA-EV Mission Governing Board

Anusandhan National Research Foundation

The EV MAHA Mission at ANRF was the first mission to be launched and we are finding new ways to ensure that the impact on Society and Market is maximised. This has involved the evolution of new administrative reforms as well as Governance reforms. The projects that were identified were a combination of different technologies in different domains- Power Electronics, Cells, Packs, Motors, Chargers, etc. While some of the projects are what one can call “Exploratory” projects, with a higher risk of failures but with very impacts, others are nil-risk “Independent Re-discovery of the Wheel” projects which ensure that India is able to have tighter control of the technology as well as the value and supply chains.

To ensure that there is a constant orientation towards Market and Industrialisation, each Work Package has been taken up with Industry partners providing inputs- from Defining Requirements, Confirming Competitiveness, Ensuring Manufacturability and Verifying Supply Chain availability. The gaps, where evident, are being filled with further Governance and Industry engagement so that we maximise impact on Society and Market.

The reforms and actions and framework adopted in this mission are being suitably cross-deployed in the other Missions- so, in a way, this is a pilot for administrative and Governance reforms in targeted and directed R&D. I congratulate the ANRF team and the 140+ researchers, across 30+ institutions, on adopting and absorbing these changes, which are significant departures from the early Research Grant models.

I wish all the Researchers the very best for the successful completion of their work packages- the country’s E-Mobility initiatives need this boost on the R&D front.

Delhi,
25 July, 2026

Mr. Karthick Athmanathan

Prof. Bhim Singh
Co-Chair, MAHA-EV Mission Governing Board

Anusandhan National Research Foundation

India's transition to electric mobility presents an unprecedented opportunity to strengthen the nation's technological capabilities while advancing sustainable transportation. Achieving this vision will require sustained excellence in research, engineering, and innovation across the entire electric mobility value chain.

The MAHA-EV Mission has been conceived to address this challenge through collaborative, mission-oriented research. Bringing together leading academic institutions, industry partners, and government agencies, the Mission seeks to accelerate advances in critical areas such as batteries, electric machines, power electronics, charging technologies, advanced materials, intelligent control systems, and recycling. These domains are inherently interconnected, and meaningful progress will depend on interdisciplinary collaboration and the effective translation of research into deployable technologies.

The work packages presented in this compendium reflect carefully identified national priorities and provide a framework for coordinated scientific and technological advancement. They encourage institutions with complementary strengths to work together, share expertise and infrastructure, and address complex engineering challenges that no single organisation can solve independently.

As researchers and engineers, our responsibility extends beyond generating new knowledge. We must develop technologies that are reliable, affordable, manufacturable, and capable of addressing India's needs while strengthening our global competitiveness. Equally important is the opportunity to nurture the next generation of scientists and engineers through participation in ambitious, application-oriented research programmes.

I hope this compendium serves as both a valuable reference and an invitation to collaborate. Through scientific excellence, engineering innovation, and sustained partnership, the MAHA-EV Mission can contribute significantly to building a resilient, self-reliant, and globally competitive electric mobility ecosystem for India.

Delhi,
25 July, 2026

Prof. Bhim Singh

Anusandhan National Research Foundation

ANRF MAHA EV MISSION

Mission for Advancement in High-impact Areas (MAHA)
Program of ANUSANDHAN NATIONAL RESEARCH FOUNDATION (ANRF)

MAHA EV MISSION SUMMIT (MEMS) 2026

ARCI
International Advanced Research Centre for Powder Metallurgy and New Materials

6	5	5	76.56 Cr
Institute Partners	Industry Partners	Work Packages	Funding

CSIR-CEERI Pilani
CSIR - Central Electronics Engineering Research Institute

3	6	4	20.57 Cr
Institute Partners	Industry Partners	Work Packages	Funding

IIT (BHU) Varanasi
Indian Institute of Technology (BHU) Varanasi

7	5	8	53.05 Cr
Institute Partners	Industry Partners	Work Packages	Funding

IIT Bombay
Indian Institute of Technology Bombay

5	26	28	63.06 Cr
Institute Partners	Industry Partners	Work Packages	Funding

IIT Kanpur
Indian Institute of Technology Kanpur

8	12	5	52.95 Cr
Institute Partners	Industry Partners	Work Packages	Funding

IIT Kharagpur
Indian Institute of Technology Kharagpur

5	14	4	20.56 Cr
Institute Partners	Industry Partners	Work Packages	Funding

NITK Surathkal
National Institute of Technology Karnataka

3	10	3	8.97 Cr
Institute Partners	Industry Partners	Work Packages	Funding


E-Node
MCTB-ARCI
Work Packages
1.1 to 1.3

Work Package 1.1

E-Node: MCTB-ARCI (Materials & Cells for Tropical Batteries)
Lead Institute: International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI)

WORK PACKAGE: Development of Materials for Li/Na/-ion/Li-S and Solid state batteries

MATERIAL TECHNOLOGIES FOR TROPICAL BATTERIES

Development of electrode material technologies for Li-ion (LMFP, high nickel NMC) as well as next generation batteries such as Na-ion (NVP, Prussian blue analogues, hard carbon), Li-S (metal/metal oxide modified C-S composites) and solid state batteries (gel polymer electrolytes).

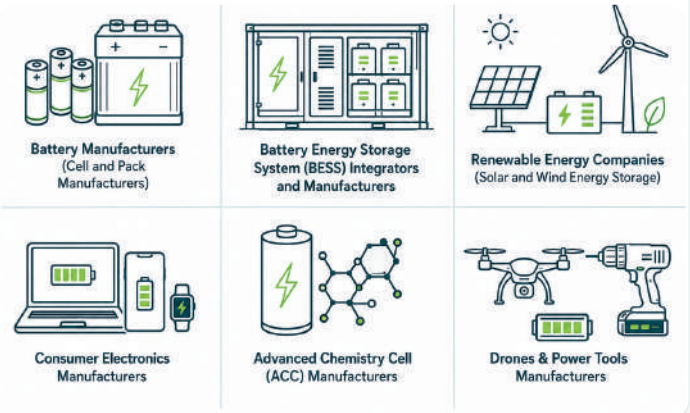
SUMMARY OF THE WORK PACKAGE

The project aims to develop, scale up, and demonstrate advanced electrode and electrolyte material technologies for next-generation rechargeable batteries. The focus is on Li-ion battery materials (NMC/NCA, LMFP, LTO, and Si-C composite anodes), Na-ion battery materials ($Na_3V_2(PO_4)_3$, Prussian Blue Analogues, and hard carbon), Li-S battery materials, and gel-polymer electrolytes for solid-state batteries. The project will develop and demonstrate scalable manufacturing processes, validate material performance in prototype cells, benchmark with commercial cells, and work towards technology transfer to industries for commercialization and deployment.

VALUE PROPOSITION:

The project delivers advanced, high-performance electrode materials for Li-ion, Na-ion, Li-S, and solid-state batteries, enabling improved energy density, safety, cycle life, and cost competitiveness. By developing scalable, indigenous cathode, anode, and electrolyte materials, the project strengthens the domestic battery materials supply chain, reduces import dependence, and supports technology commercialization. The developed materials will enable reliable, sustainable, and cost-effective manufacturing of next-generation batteries for electric mobility, stationary energy storage, and strategic applications in India.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 6

INSTITUTION PARTNERS
5

INDUSTRY PARTNERS
3

IP STATUS
11 GRANTED
17 FILED

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Hyderabad • Indian Institute of Technology Tirupati • Indian Institute of Technology Bhilai • CSIR-Indian Institute of Chemical Technology, Hyderabad • National Institute of Technology, Warangal	• Altmin Private Limited • Amara Raja Advanced Cell Technologies • Himadri Speciality Chemicals Limited

TECHNOLOGY OUTREACH LINK:

https://x.com/arci_res_in/status/2000104376464286091

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Work Package 1.2

E-Node: MCTB-ARCI (Materials & Cells for Tropical Batteries)
Lead Institute: International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI)

WORK PACKAGE: **Establishment of 2 MWh Rapid Prototyping Facility for development, demonstration, and validation of cell fabrication technologies**

2MWH RAPID PROTOTYPING FACILITY FOR CYLINDRICAL AND PRISMATIC CELLS

This work package establishes a 2 MWh rapid prototyping facility to manufacture and validate cylindrical (2-25Ah) and prismatic (up to 50Ah) cells in various standard formats. The facility will enable pilot-scale production of up to 150 cylindrical cells and 50 prismatic cells per day, supporting the demonstration of advanced battery technologies for adaptation by industries.

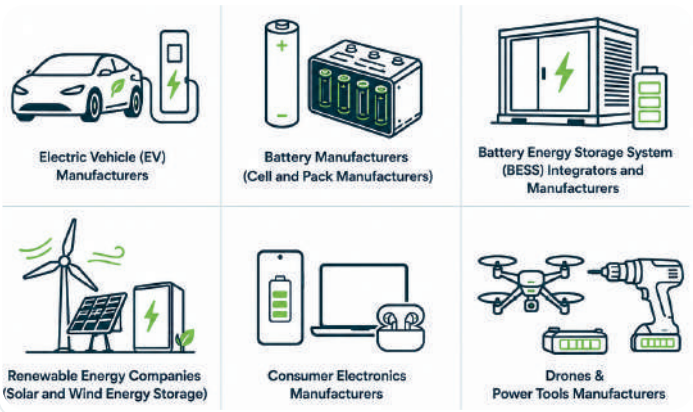
SUMMARY OF THE WORK PACKAGE

This work package focuses on establishing a 2 MWh rapid prototyping facility for the pilot-scale manufacturing of advanced rechargeable battery cells. The facility is capable of fabricating cylindrical cells (18650, 21700, 32140, and 4680 formats) and prismatic cells (up to 50 Ah capacity), enabling the translation of laboratory-scale innovations into industry-relevant prototypes. It will support electrode processing, cell assembly, formation, testing, validation, performance benchmarking, and quality evaluation under standardized conditions. The facility will accelerate technology deployment, facilitate industry collaboration, and bridge the gap between material development and commercial-scale battery manufacturing. The facility will also support industries in validating ACC components for establishing the supply chain, start-ups for prototyping, and academic and R&D institutes in making cells and systems using the materials developed by them.

VALUE PROPOSITION:

One-stop solution for pilot-scale manufacturing, testing, validation, and benchmarking of cells. The facility accelerates the qualification and standardization of Advanced Chemistry Cell (ACC) components, reduces the time from laboratory innovation to commercial deployment, and supports industries in developing market-ready battery technologies. It also provides a national platform for product validation, process optimization, and faster commercialization of indigenous energy storage solutions.

TYPE OF END CUSTOMER



PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• TATA Motors Limited

TECHNOLOGY OUTREACH LINK:

NIL

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Work Package 1.3

E-Node: MCTB-ARCI (Materials & Cells for Tropical Batteries)
Lead Institute: International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI)

WORK PACKAGE: Development of Indigenous equipment to manufacture materials and cells

INDIGENOUS EQUIPMENT FOR BATTERIES AND MATERIALS

This work package focuses on developing indigenous semi-automatic processing equipment for manufacturing cylindrical and prismatic cells, and a continuous-flow reactor for advanced NMC cathode materials.

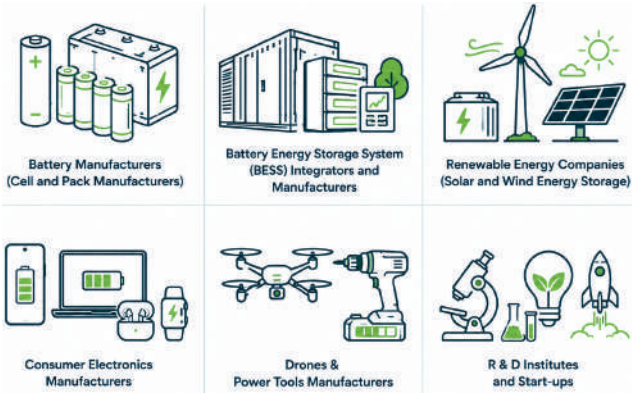
SUMMARY OF THE WORK PACKAGE

This work package focuses on the design, development, and demonstration of indigenous semi-automatic processing equipment for manufacturing cylindrical and prismatic battery cells. It also includes the design and development of a continuous flow reactor for the scalable production of advanced NMC cathode materials. The developed technologies will strengthen indigenous manufacturing capabilities, improve process efficiency and product quality, reduce dependence on imported equipment, and accelerate the commercialization of advanced battery manufacturing technologies in India.

VALUE PROPOSITION:

Establishment of capacity and capability to manufacture equipment for the battery ecosystem in India. Reduced import dependence, lower manufacturing costs and improved production efficiency. Strengthen reliable battery manufacturing capability and develop expertise to introduce new cell designs. Promote export of materials, cells and packs.

TYPE OF END CUSTOMER



PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Information Technology, Design and Manufacturing, Kancheepuram • National Institute of Technology, Warangal	• Innovative Filtrex

TECHNOLOGY OUTREACH LINK:

NIL

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E-Node
CSIR-CEERI PILANI

Work Packages
2.1 to 2.12

Work Package 2.1

E-Node: CSIR-CEERI PILANI
Lead Institute: CSIR-CEERI PILANI, Rajasthan

WORK PACKAGE: Design and Development of high-power D-E mode GaN HEMT

NEXT-GENERATION WBG BASED POWER DEVICES

This work package focuses on developing advanced power devices for electric vehicles to improve energy efficiency, reliability, and overall vehicle performance.

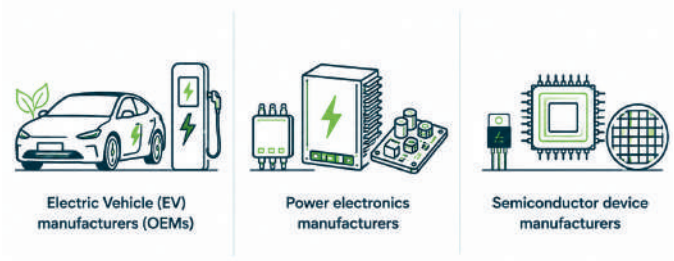
SUMMARY OF THE WORK PACKAGE

This work package focuses on the design, fabrication, characterization, and demonstration of high-voltage GaN High Electron Mobility Transistors (HEMTs) on silicon (Si) and other substrates for next-generation electric vehicle (EV) power electronics. The developed devices will support both depletion-mode (D-mode) and enhancement-mode (E-mode) operation, targeting a breakdown voltage of 650–1200 V. The work includes device design, process development, fabrication, electrical characterization, and performance optimization to achieve the desired electrical specifications. Prototype devices will be integrated and evaluated in representative EV power conversion applications to validate their performance under realistic operating conditions.

VALUE PROPOSITION:

The developed high-voltage GaN HEMT technology provides a high-efficiency, high-performance, and reliable power semiconductor solution for electric vehicle applications. It enables reduced power losses, faster switching, improved power density, and more compact power conversion systems, helping EV manufacturers achieve longer driving range, improved energy efficiency, reduced cooling requirements, and enhanced overall vehicle performance.

TYPE OF END CUSTOMER



PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay • Indian Institute of Technology Mandi • Indian Institute of Technology Roorkee	• NA

TECHNOLOGY OUTREACH LINK:

https://www.youtube.com/watch?v=CyPOrDd0kSE

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Work Package 2.2

E-Node: CSIR-CEERI PILANI
Lead Institute: IIT Bombay

WORK PACKAGE: **Indigenous Design and Fabrication of Wide Bandgap Power Device Technologies**

INDIGENOUS GAN EV POWER ELECTRONICS DEVELOPMENT

Building indigenous GaN strategic semiconductor technology for high-efficiency EV power components that improve vehicle performance, reliability and energy efficiency while strengthening India's EV manufacturing ecosystem.

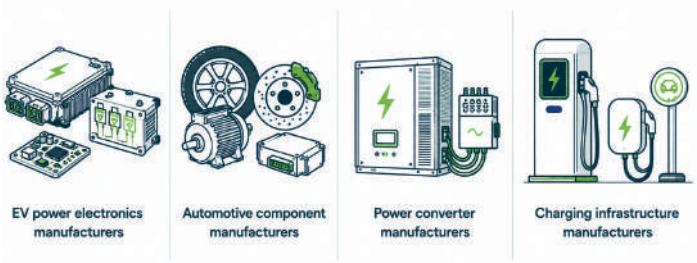
SUMMARY OF THE WORK PACKAGE

This work package develops indigenous lateral and vertical GaN HEMT technologies (650–1500 V) for high-efficiency EV power converters. It encompasses heterostructure design, device fabrication, characterization, packaging, prototype demonstration, and validation to enable compact, energy-efficient, and reliable EV power electronics while establishing a core indigenous technology platform with strong technology transfer and commercialization potential.

VALUE PROPOSITION:

The technology enables compact, energy-efficient, and highly reliable EV power converters through indigenous high-voltage GaN power devices with lower switching losses and higher power density. It reduces dependence on imported semiconductor technologies, lowers overall system cost, improves manufacturing competitiveness, and provides a scalable platform for commercialization, supporting India's transition towards self-reliant and sustainable electric mobility.

TYPE OF END CUSTOMER



PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay	• NA

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 2.3

E-Node: CSIR-CEERI PILANI
Lead Institute: CSIR-CEERI PILANI, Rajasthan

WORK PACKAGE: Design and Development of Silicon Carbide High Power Devices for Electric Vehicles

EFFICIENT SIC POWER DIODES

Development of high-voltage 4H-SiC Schottky power diodes through device design, Silvaco TCAD simulation, fabrication and characterization for efficient, reliable and indigenous wide-bandgap power electronics.

SUMMARY OF THE WORK PACKAGE

This work package aims to develop high-performance 4H-SiC Schottky power diodes with a high breakdown voltage of more than 650 V, a forward current of 10A and fast switching capability. The work includes TCAD-based device optimization, process development, cleanroom fabrication, prototype realization and electrical characterization. The developed technology supports indigenous wide-bandgap semiconductor devices for electric vehicles, renewable energy systems, industrial power converters and smart-grid applications.

VALUE PROPOSITION:

The developed SiC power diode offers higher efficiency, lower switching and conduction losses, superior thermal performance and higher reliability than conventional silicon devices. It enables compact, energy-efficient power converters while supporting indigenous manufacturing of advanced wide-bandgap semiconductor technology.

TYPE OF END CUSTOMER

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay • Indian Institute of Technology Mandi • Indian Institute of Technology Roorkee	• NA

TECHNOLOGY OUTREACH LINK:

https://youtu.be/CyPOrDd0kSE

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Work Package 2.4

E-Node: CSIR-CEERI PILANI
Lead Institute: CSIR-CEERI PILANI, Rajasthan

WORK PACKAGE: Design and Development of Gallium Oxide Power FETs

NEXT-GENERATION SEMICONDUCTOR POWER SOLUTIONS

This work package focuses on developing next-generation, innovative power components to make high-performance electrical systems more energy-efficient, reliable, and suitable for electric vehicles, future transportation, industrial, and clean/renewable energy systems.

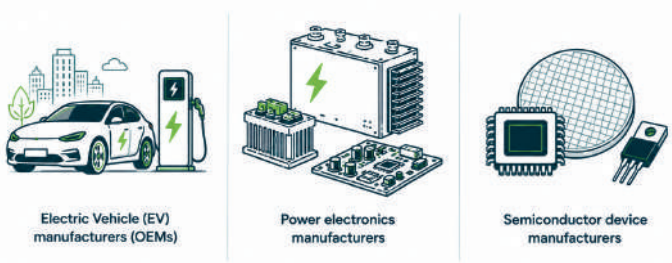
SUMMARY OF THE WORK PACKAGE

The project focuses on the development of a high-voltage Gallium Oxide-based power MOSFET. Device simulation optimizes the epitaxial structure of gallium oxide for achieving superior electrical performance. The optimized design enables a device layout targeting an output voltage >1 kV to be developed. Fabrication process flow, mask design, fabrication, and optimization of individual unit processes will then be established. Finally, developed MOSFETs will undergo DC electrical characterization to evaluate their performance, including breakdown voltage and leakage current, ensuring the targeted high-voltage applications.

VALUE PROPOSITION:

The developed Gallium Oxide power MOSFET technology will enable compact, energy-efficient and highly reliable power electronic systems capable of operating at high voltages (>1 kV) with reduced power losses. The technology will support applications in electric vehicles, renewable energy systems, industrial power converters, and smart grids by improving efficiency, reducing cooling requirements, and lowering overall system size and cost. In addition, the work will contribute to strengthening indigenous semiconductor technology and reducing dependence on imported high-power electronic devices.

TYPE OF END CUSTOMER



PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay • Indian Institute of Technology Mandi • Indian Institute of Technology Roorkee	• NA

TECHNOLOGY OUTREACH LINK:

https://youtu.be/CyPOrDd0kSE

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Work Package 2.5

E-Node: CSIR-CEERI PILANI
Lead Institute: CSIR-CEERI PILANI, Rajasthan

WORK PACKAGE: **Design and development of high voltage inverters in the range of 400V to 1500V DC**

SMOOTH, SILENT, EFFICIENT MOTOR DRIVE

Compact, highly efficient power electronics that drive an electric vehicle's motor, with built-in intelligence that constantly watches for faults and keeps the vehicle safe.

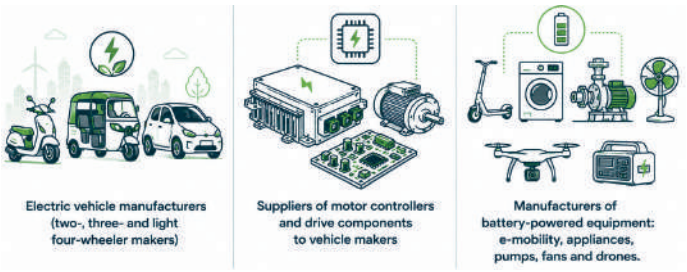
SUMMARY OF THE WORK PACKAGE

This work package develops next-generation power electronics and motor drives for electric vehicles using wide-bandgap semiconductor devices, covering systems from 24V to 72V, supporting 2-, 3-, and light 4-wheeler vehicles. These devices switch faster and waste far less energy than conventional silicon, enabling smaller, lighter and more efficient drives. An integrated safety control framework continuously monitors voltages, currents, and motor behaviour, detects faults within microseconds, and safely shuts the system down. Laboratory prototypes of GaN-based motor drives with advanced digital control have been demonstrated.

VALUE PROPOSITION:

Wide-bandgap inverters cut energy losses significantly compared with silicon, translating directly into longer driving range or a smaller, cheaper battery. Faster switching shrinks the size and weight of the drive electronics, freeing vehicle space and lowering cost. The built-in safety framework provides real-time fault detection and safe shutdown, easing compliance with automotive functional-safety standards. As an indigenously developed platform, it reduces import dependence and offers customers a customisable, locally supported drive solution.

TYPE OF END CUSTOMER



PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay • Indian Institute of Technology Mandi • Indian Institute of Technology Roorkee	• NA

TECHNOLOGY OUTREACH LINK:

NA

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Website Link: https://www.ceeri.res.in/

Work Package 2.6

E-Node: CSIR-CEERI PILANI
Lead Institute: Indian Institute of Technology Roorkee

WORK PACKAGE: Design and control of Synchronous Reluctance Motor (SynRM) for Traction Applications

INDIGENOUS RARE-EARTH-FREE EV DRIVE

This project develops an affordable, eco-friendly drive system for all electric vehicles by eliminating the use of scarce rare-earth metals. It maximizes battery power by pairing a specially designed, magnet-free motor with high-efficiency electronics.

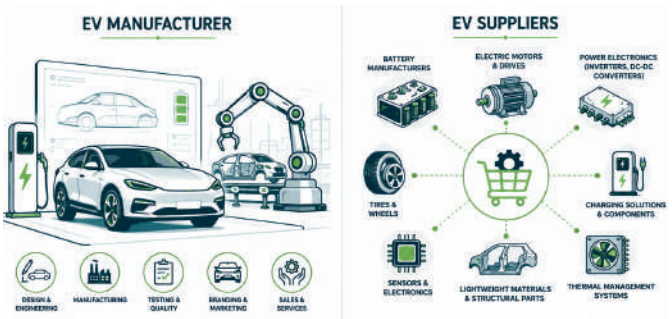
SUMMARY OF THE WORK PACKAGE

This project develops an indigenous, rare-earth-free drive system for both light and heavy electric vehicles. By completely eliminating the reliance on imported magnet materials, it builds a self-reliant technology chain. The work involves designing a highly efficient, magnet-free motor and pairing it with advanced power electronics to maximize battery performance. The system will be rigorously modelled and tested at higher power levels to guarantee a robust, scalable, and sustainable solution for future electric mobility in India.

VALUE PROPOSITION:

This indigenous traction system offers EV manufacturers a secure, cost-effective alternative to traditional motors. By eliminating the reliance on expensive, imported rare-earth metals, it protects supply chains from global shocks and lowers production costs. For EV owners, pairing our robust, magnet-free motor with advanced electronics ensures a reliable, affordable, and eco-friendly vehicle with maximized battery range. Ultimately, it delivers a versatile, highly efficient drive solution scalable from compact city cars to heavy commercial trucks.

TYPE OF END CUSTOMER



PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay • Indian Institute of Technology Mandi • CSIR-CEERI PILANI	• TATA Motors • Mahindra EV • Hyundai

TECHNOLOGY OUTREACH LINK:

https://youtu.be/CyPOrDd0kSE

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Work Package 2.7

E-Node: CSIR-CEERI PILANI
Lead Institute: CSIR-CEERI PILANI

WORK PACKAGE: Development of wideband gap-based inverters, motor drive (400-1500 V) and integrated safety control framework

INTEGRATED SAFETY CONTROL FRAMEWORK FOR HIGH VOLTAGE DC-DC CONVERTERS: LEVERAGING MONITORING, PREDICTIVE MAINTENANCE, AND COMPLIANCE WITH INDUSTRY STANDARDS

Design a modular framework that can be adapted for various applications, including electric vehicles, renewable energy systems, and industrial power supplies. To incorporate advanced condition-monitoring systems and machine learning algorithms to predict and prevent failures, reducing downtime and maintenance costs.

SUMMARY OF THE WORK PACKAGE

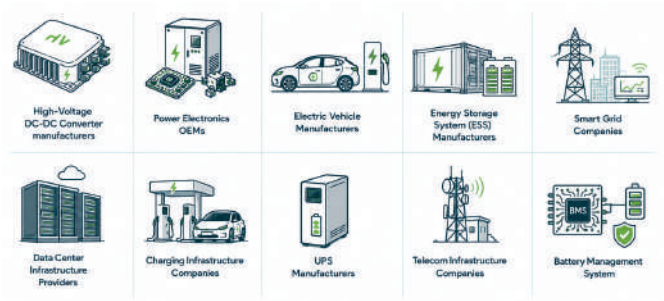
Develop real-time monitoring systems with integrated sensors to track key parameters such as voltage, current, and temperature, ensuring a prompt response to abnormal conditions.
Incorporate advanced condition-monitoring systems and machine learning algorithms to predict and prevent failures, reducing downtime and maintenance costs. Design a modular framework that can be adapted for various applications, including electric vehicles, renewable energy systems, and industrial power supplies.

VALUE PROPOSITION:

The platform enables real-time converter health monitoring, intelligent fault prediction, automated safety control, and compliance with international safety standards. It minimises unexpected failures, extends equipment life, reduces maintenance costs, and improves operational reliability in mission-critical power electronic systems. The platform provides advanced technical capabilities that are typically unavailable in conventional converter protection systems:

- Multi-sensor data fusion, AI-based fault diagnosis, Remaining Useful Life (RUL) estimation, Component health index calculation, Thermal stress analysis, Electrical stress monitoring, Intelligent alarm prioritization, Adaptive protection thresholds, Event logging and diagnostics, Digital twin compatibility, Cyber-ready remote monitoring architecture.

TYPE OF END CUSTOMER



PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay • Indian Institute of Technology Mandi • Indian Institute of Technology Roorkee	• NA

TECHNOLOGY OUTREACH LINK:

https://youtu.be/CyPOrDd0kSE

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Work Package 2.8

E-Node: CSIR-CEERI PILANI
Lead Institute: Indian Institute of Technology, Mandi

WORK PACKAGE: WBG based high power converters and their subsystems for high temperatures and low loss operation

EFFICIENT EV POWER CONVERSION

Developing high-efficiency GaN-based DC–DC converters that reduce power loss while delivering compact, lightweight, and reliable power conversion for electric vehicles.

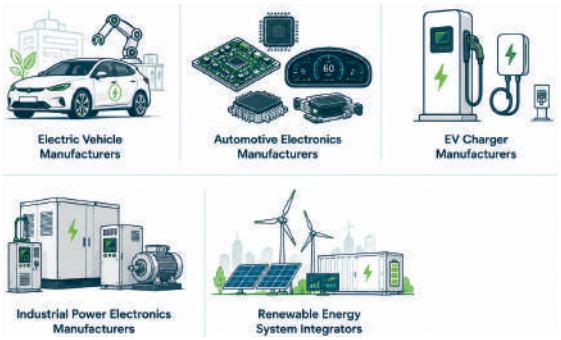
SUMMARY OF THE WORK PACKAGE

This work package focuses on the design, simulation, and development of GaN-based DC–DC power converters for electric vehicle applications. The objective is to achieve higher efficiency, reduced switching losses, compact size, and improved power density. PCB design, converter modelling, power loss analysis, and hardware implementation are being carried out to demonstrate reliable converter operation for next-generation EV systems.

VALUE PROPOSITION:

The developed converter technology offers higher efficiency, lower switching losses, compact size, improved power density, and reduced energy consumption, resulting in more efficient and reliable electric vehicle power systems.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 3-4

INSTITUTION PARTNERS
4

INDUSTRY PARTNERS
NA

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay • Indian Institute of Technology Mandi • Indian Institute of Technology Roorkee • CSIR-CEERI Pilani	• NA

TECHNOLOGY OUTREACH LINK:

https://www.youtube.com/watch?v=Or2NHsIwU1Q

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Work Package 2.9

E-Node: CSIR-CEERI PILANI
Lead Institute: Indian Institute of Technology Mandi

WORK PACKAGE: **Design and development of new paradigm thermal management systems for power electronic**

SMART COOLING FOR EV ELECTRONICS

Developing efficient cooling solutions for GaN-based power converters using thermal simulations and experimental validation to improve reliability and operating life.

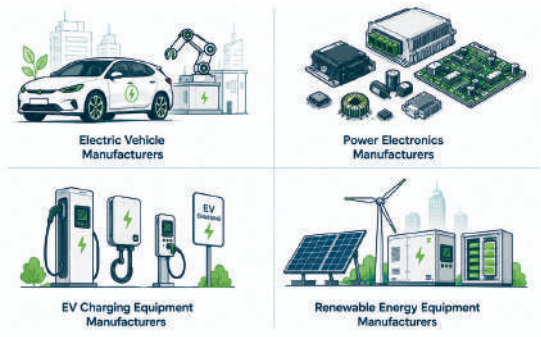
SUMMARY OF THE WORK PACKAGE

This work package develops thermal management solutions for GaN-based DC–DC power converters using ANSYS Icepak simulations and experimental validation. Different heat sink designs and airflow configurations are investigated to reduce operating temperature and improve heat dissipation. A dedicated copper block test setup is being developed to validate simulation results. The work aims to enhance reliability, efficiency, and lifetime of next-generation EV power electronics

VALUE PROPOSITION:

Provides optimized thermal management solutions that improve cooling performance, increase converter reliability, reduce thermal stress, and enable compact and energy-efficient EV power electronics.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 3-4

INSTITUTION PARTNERS
4

INDUSTRY PARTNERS
NA

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay • Indian Institute of Technology Mandi • Indian Institute of Technology Roorkee • CSIR-CEERI Pilani	• NA

TECHNOLOGY OUTREACH LINK:

https://www.youtube.com/watch?v=Or2NHsIwU1Q

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Work Package 2.10

E-Node: CSIR-CEERI PILANI
Lead Institute: Indian Institute of Technology Roorkee

WORK PACKAGE: Design and development of 120kW DC Fast Charger with V2G and G2V modes

TWO-WAY EV CHARGING SYSTEM

Development of a 120 kW indigenous bidirectional EV fast-charging platform by creating critical technology building blocks and strengthening the domestic supply chain for high-power charging infrastructure.

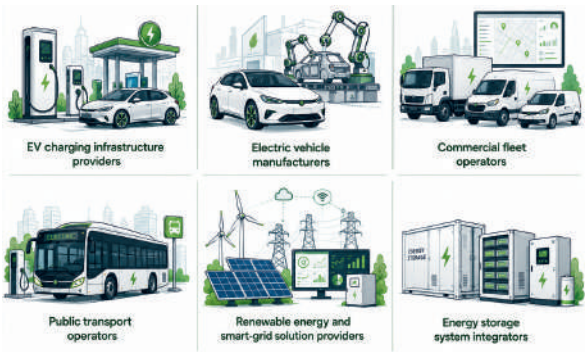
SUMMARY OF THE WORK PACKAGE

This work package focuses on the development of an indigenous 120 kW bidirectional DC fast charger with V2G and G2V capabilities. Key technologies including high-efficiency power converter modules, high-frequency isolation, advanced control hardware, gate drivers, sensing, protection, and thermal solutions are being developed to strengthen the domestic EV charger supply chain. The modular architecture enables scalable, reliable, and cost-effective charging infrastructure for future electric mobility applications.

VALUE PROPOSITION:

The developed platform aims to establish a complete indigenous technology ecosystem for high-power EV chargers by reducing dependency on imported converter modules and critical subsystems. Development of key building blocks such as power modules, control platforms, gate-driver solutions, and system integration know-how will enable local manufacturing capability. The scalable design provides improved efficiency, easier maintenance, reduced lifecycle cost, and supports future smart-grid applications through bidirectional power transfer.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 4

INSTITUTION PARTNERS
2

INDUSTRY PARTNERS
1

IP STATUS
1 Filed

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Roorkee • CSIR-CEERI Pilani	• Statcon Energia Pvt. Ltd.

TECHNOLOGY OUTREACH LINK:

https://youtu.be/Vw2ZEaC4k6Y?si=VPFTxysZ-BVZYDpi

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Work Package 2.11

E-Node: CSIR-CEERI PILANI
Lead Institute: CSIR-CEERI PILANI

WORK PACKAGE: Development of Modular Converter Architecture for high-frequency inverters

MODULAR HIGH-FREQUENCY POWER SYSTEM

Modular and scalable inverter system that provides efficient and reliable power with built-in security and continuous monitoring to protect against cyber threats.

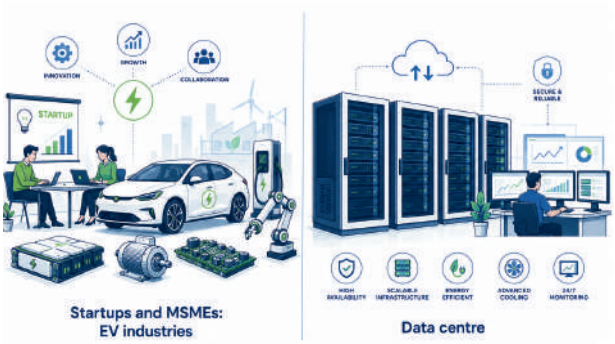
SUMMARY OF THE WORK PACKAGE

Develop a SiC/GaN-based modular high-frequency inverter with a stackable architecture scalable by integrating bidirectional AC-DC and DC-DC converters, advanced control, sensing, and system management. The inverter incorporates secure communication protocols, real-time anomaly and intrusion detection, and cybersecurity features to protect against unauthorized access and cyber threats while delivering high efficiency, reliable operation, and scalable performance for next-generation power conversion applications.

VALUE PROPOSITION:

Provides a compact, high-efficiency, and scalable inverter platform that delivers reliable power conversion with built-in cybersecurity, enabling secure, high-performance, and future-ready energy systems.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 2

INSTITUTION PARTNERS
3

INDUSTRY PARTNERS
NA

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay • Indian Institute of Technology Mandi • Indian Institute of Technology Roorkee	• NA

TECHNOLOGY OUTREACH LINK:

https://youtu.be/CyPOrDd0kSE

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Work Package 2.12

E-Node: CSIR-CEERI PILANI
Lead Institute: CSIR-CEERI PILANI

WORK PACKAGE: Modular Architecture of DC-DC Converters and Onboard Charging System

MODULAR VEHICLE POWER SYSTEMS

Modular EV charging and power conversion system that delivers better performance, and improves system reliability.

SUMMARY OF THE WORK PACKAGE

Develop a modular onboard charging and DC-DC power-conversion system for electric vehicles using wide-bandgap SiC/GaN devices. The architecture integrates an AC-DC converter, an isolated DC-DC converter, with intelligent control, condition monitoring, and health management to enhance reliability and scalability for next-generation high-voltage EV charging systems.

VALUE PROPOSITION:

Provides a compact, energy-efficient, and reliable EV charging and power conversion platform. Its modular design enables scalability, lower operating costs, and compatibility with next-generation electric vehicles.

TYPE OF END CUSTOMER

TECHNOLOGY READINESS LEVEL
TRL 2

INSTITUTION PARTNERS
3

INDUSTRY PARTNERS
NA

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay • Indian Institute of Technology Mandi • Indian Institute of Technology Roorkee	• NA

TECHNOLOGY OUTREACH LINK:

https://youtu.be/CyPOrDd0kSE

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E-Node
IIT (BHU) Varanasi

Work Packages
3.1 to 3.8

Work Package 3.1

E-Node: IIT (BHU) Varanasi
Lead Institute: IIT (BHU) Varanasi

WORK PACKAGE: Degradation-Resistant Battery Pack

DEGRADATION-RESISTANT BATTERY PACK

This work package focuses on understanding the degradation of commercially available batteries under tropical conditions. It aims to develop mitigation strategies for designing and fabricating degradation-resistant battery packs.

SUMMARY OF THE WORK PACKAGE

This work package aims to develop safe, long-life, high-energy battery packs for tropical electric mobility by reducing battery degradation through advanced materials, intelligent engineering, and physics-informed design. The work combines accelerated ageing experiments with predictive multi-scale modelling to understand, predict, and mitigate battery degradation. The proposed 2-10 Ah pouch cells with a 400 Wh/kg capacity will be integrated with intelligent battery management systems (iBMS), advanced thermal management, and sustainable agro-derived packaging to develop indigenous battery packs with a 250 Wh/kg capacity for next-generation EVs.

VALUE PROPOSITION:

Indigenous degradation-resistant battery packs are specifically engineered for reliable operation in tropical climates. By mitigating battery degradation under high-temperature, high-humidity conditions, the technology delivers longer battery life, enhanced safety, faster charging, and improved operational reliability, while reducing total cost of ownership and alleviating driver range anxiety. Designed for electric mobility, aerospace, naval, defence, and grid energy storage applications, the solution strengthens India's indigenous battery manufacturing capability and supports sustainable electric mobility.

TYPE OF END CUSTOMER

TECHNOLOGY READINESS LEVEL
TRL 3

INSTITUTION PARTNERS
3

INDUSTRY PARTNERS
3

IP STATUS
2 Granted
1 Filed

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Kharagpur	• TATA Motors
• Naval Science & Technological Laboratory (NSTL)	• TVS Motors
• National Aerospace Laboratories (NAL)	• OPAL-RT Technologies

TECHNOLOGY OUTREACH LINK:

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Work Package 3.2

E-Node: IIT (BHU) Varanasi
Lead Institute: IIT (BHU) Varanasi

WORK PACKAGE: Degradation-shielded EV Chargers with an Agile BMS (ABMS)

DEGRADATION-SHIELDED EV CHARGERS WITH AN AGILE BMS (ABMS)

This work package aims to develop an intelligent on-board fast charger that uses fractional power processing and integrates a hybrid energy storage system with an ABMS to enhance the safety, efficiency, and lifespan of EV batteries under tropical operating conditions.

SUMMARY OF THE WORK PACKAGE

This work package enhances EV battery safety, performance, and lifespan through intelligent power electronic interfaces and advanced battery management. It develops a 6.6 kW Level 2 onboard fractional power processing unit (PPU) integrated with supercapacitors to reduce battery stress, improve charger efficiency, and enhance thermal stability under tropical conditions. An ABMS estimates material degradation, SoC, predicts Remaining Useful Life (RUL), issues safety alerts, performs active cell balancing, and leverages AI-based diagnostics and predictive analytics to enhance battery reliability and overall EV performance.

VALUE PROPOSITION:

The platform provides safe, intelligent, and cost-effective EV battery charging and management solutions for tropical conditions. Combining a supercapacitor-assisted charger and fractional power processing units with an ABMS enables faster charging, reduces battery degradation, extends battery life, and improves energy efficiency. AI-based diagnostics, battery health prediction, and active cell balancing enhance safety, reliability, and performance while reducing maintenance costs and overall ownership expenses.

TYPE OF END CUSTOMER

TECHNOLOGY READINESS LEVEL
TRL 4

INSTITUTION PARTNERS
3

INDUSTRY PARTNERS
3

IP STATUS
4 Granted
1 Filed

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Kharagpur • Naval Science & Technological Laboratory (NSTL) • National Aerospace Laboratories (NAL)	• TATA Motors • TVS Motors • OPAL-RT Technologies

TECHNOLOGY OUTREACH LINK:

http://www.linkedin.com/in/te-mobix-anrf-maha-ev-mission-445b54418

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Work Package 3.3

E-Node: IIT (BHU) Varanasi
Lead Institute: IIT (BHU) Varanasi

WORK PACKAGE: Second Life of Batteries – towards Circular Economy

SECOND LIFE OF BATTERIES – TOWARDS CIRCULAR ECONOMY

This work package develops 'Punarnava', a circular economy framework for maximizing the value of end-of-life EV batteries through second-life applications, critical mineral recovery, and sustainable battery lifecycle management.

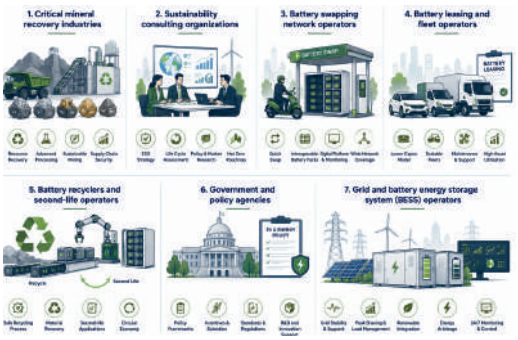
SUMMARY OF THE WORK PACKAGE

This work package develops Punarnava, a data-driven circular economy platform that maximizes the value of end-of-life EV batteries by integrating second-life applications, critical mineral recovery, and reverse logistics. It employs dynamic material flow analysis, battery traceability, and ecosystem modelling to identify spatiotemporal waste generation and optimize battery reuse. The work delivers open-source decision-support tools and policy dashboards to strengthen sustainable battery circularity, resource efficiency, and evidence-based decision-making under tropical operating conditions.

VALUE PROPOSITION:

Punarnava enables organizations to maximize the value of end-of-life EV batteries through intelligent second-life deployment, critical mineral recovery, and optimized reverse logistics. The platform reduces lifecycle costs, improves resource efficiency, supports regulatory compliance, and strengthens battery traceability through data-driven decision support. Designed for recyclers, fleet operators, and policymakers, Punarnava accelerates India's transition towards a sustainable battery circular economy while enhancing national resource security and responsible energy storage.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 3

INSTITUTION PARTNERS
3

INDUSTRY PARTNERS
NA

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Kharagpur • Chalmers University of Technology, Sweden • KTH Royal Institute of Technology, Sweden	• NA

TECHNOLOGY OUTREACH LINK:

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Work Package 3.4

E-Node: IIT (BHU) Varanasi
Lead Institute: IIT (BHU) Varanasi

WORK PACKAGE: Battery Health Analysis Indicator (BHAI)

BATTERY HEALTH ANALYSIS INDICATOR (BHAI)

This work package develops the Battery Health Analysis Indicator (BHAI), a unified framework to quantify, predict, and benchmark battery health, safety, and remaining useful life while establishing a price-performance indicator for battery usage, reuse, and swapping.

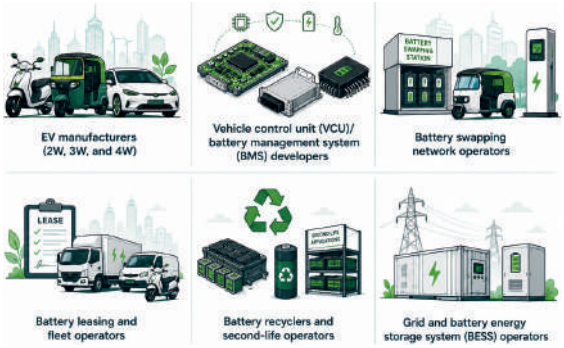
SUMMARY OF THE WORK PACKAGE

This work package develops the Battery Health Analysis Indicator (BHAI), an intelligent platform for real-time battery health monitoring, safety assessment, and lifetime prediction. The work combines experimental battery data with physics-informed artificial intelligence to predict battery degradation, remaining useful life, and thermal safety under tropical operating conditions. The platform will establish a unified price-performance metric to support battery swapping, second-life applications, and digital twin-enabled battery management for safer, more reliable, and sustainable electric mobility.

VALUE PROPOSITION:

BHAI enables accurate battery health assessment, remaining useful life prediction, and real-time safety monitoring throughout the battery lifecycle. The platform supports intelligent battery swapping, second-life utilization, and predictive maintenance while reducing battery replacement costs and minimizing operational downtime. By providing a unified price-performance indicator, BHAI improves battery valuation, enhances user confidence, and supports data-driven decision-making for electric mobility, grid energy storage, and circular economy applications, strengthening India's battery intelligence ecosystem.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL: TRL 2

INSTITUTION PARTNERS: 3

INDUSTRY PARTNERS: 1

IP STATUS: NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Kharagpur • Naval Science & Technological Laboratory (NSTL) • National Aerospace Laboratories (NAL)	• ThoughtSpot India Pvt. Ltd.

TECHNOLOGY OUTREACH LINK:

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Work Package 3.5

E-Node: IIT (BHU) Varanasi
Lead Institute: IIT (BHU) Varanasi

WORK PACKAGE: Demonstration of Rechargeable Zinc-Air Battery for EVs

DEMONSTRATION OF RECHARGEABLE ZINC-AIR BATTERY FOR EVS

The proposed work will focus on the design, fabrication, and demonstration of a rechargeable zinc-air battery with high energy density and long cycle life, suitable for electric vehicle (EV) applications.

SUMMARY OF THE WORK PACKAGE

We propose the Zn-air battery as an efficient, cost-effective, and environment friendly alternative to current Li-ion battery technology for EV applications. In this work package, we aim to synthesize suitable electrocatalyst and investigate their activity study, design Zn-air battery cells using appropriate electrocatalyst for the air cathode, and evaluate their performance in terms of energy density, specific capacity, power density, and cyclic stability, followed by a comprehensive performance study of the Zn-air battery pack for EV applications.

VALUE PROPOSITION:

The demonstrated rechargeable zinc-air battery may provide a safe, cost-effective, environmentally friendly and sustainable energy storage solution with high energy density. It may offer reduced dependence on critical materials like Lithium, Cobalt, etc., improved energy density, and lower manufacturing costs compared to conventional Li-ion batteries. The technology is suitable for electric vehicles and stationary energy storage, enabling reliable, clean energy solutions while supporting India's goals for sustainable transportation and energy security.

TYPE OF END CUSTOMER

TECHNOLOGY READINESS LEVEL
TRL 4

INSTITUTION PARTNERS
2

INDUSTRY PARTNERS
1

IP STATUS
1 Filed

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Banaras Hindu University • Institute of Chemical Technology (ICT), Mumbai	• Urjawatt Technologies Private Limited

TECHNOLOGY OUTREACH LINK:

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Work Package 3.6

E-Node: IIT (BHU) Varanasi
Lead Institute: IIT (BHU) Varanasi

WORK PACKAGE: Battery Fabrication, Lifecycle, Evaluation, Xharacterization (BAT-FLEX) Facilities

BATTERY FABRICATION, LIFECYCLE, EVALUATION, XHARACTERIZATION (BAT-FLEX) FACILITIES

This work package ensures the seamless execution of the research by establishing the Battery Fabrication, Lifecycle, Evaluation, Xharacterization (BAT-FLEX) facility to support testing, fabrication, and training needs.

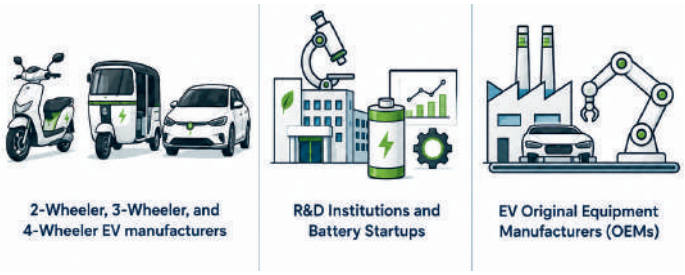
SUMMARY OF THE WORK PACKAGE

The BAT-FLEX initiative establishes a state-of-the-art facility for battery testing, fabrication, and validation tailored to India's energy needs. It features advanced pouch cell fabrication lines maintained under precise, contamination-free environmental controls to support next-generation chemistries. To accelerate commercialization, the facility standardizes comprehensive performance and lifecycle testing protocols. Furthermore, BAT-FLEX qualifies innovative electrode and electrolyte materials for cost-effective production and provides rigorous safety testing services including thermal runaway and mechanical abuse characterizations, ensuring highly reliable energy storage solutions.

VALUE PROPOSITION:

The primary objective of this work package is to establish a National Battery Research Facility in India to serve as the cornerstone for the nation's energy storage revolution by bridging the gap between fundamental research and commercialization. By providing a comprehensive testing, fabrication, and validation ecosystem, it accelerates domestic innovation in next-gen chemistries. Economically, the national facility boosts manufacturing competitiveness, standardizes uniform performance protocols, and secures local supply chains. Its rigorous thermal and mechanical safety characterizations significantly mitigate risks, providing strategic, data-driven insights through a centralized repository to ensure a safer, sustainable, and self-reliant Indian battery industry.

TYPE OF END CUSTOMER



PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Kharagpur • Banaras Hindu University • Institute of Chemical Technology (ICT), Mumbai • DRDO – Naval Science & Technological Laboratory (NSTL) • CSIR – National Aerospace Laboratories (NAL)	• TATA Motors • TVS Motors • OPAL-RT Technologies India Pvt. Ltd. • ThoughtSpot Inc. • Urjawatt Technologies Pvt. Ltd.

TECHNOLOGY OUTREACH LINK:

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Work Package 3.7

E-Node: IIT (BHU) Varanasi
Lead Institute: IIT (BHU) Varanasi

WORK PACKAGE: Project Coordination and Management

PROJECT COORDINATION AND MANAGEMENT

This work package ensures the project is managed efficiently by coordinating all partners, tracking progress, managing budgets and timelines, and resolving issues promptly.

SUMMARY OF THE WORK PACKAGE

This work package ensures the effective coordination and management of the project by overseeing technical, administrative, and financial activities. It monitors progress, milestones, deliverables, budgets, and timelines while supporting quality assurance and transparent communication among all partners. Through regular reviews, structured decision-making, and timely resolution of issues, this work package ensures smooth project execution and the successful achievement of project objectives.

VALUE PROPOSITION:

NA

TYPE OF END CUSTOMER

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Kharagpur • Banaras Hindu University • Institute of Chemical Technology (ICT), Mumbai • DRDO – Naval Science & Technological Laboratory (NSTL) • CSIR – National Aerospace Laboratories (NAL) • Chalmers University of Technology (Sweden) • KTH Royal Institute of Technology (Sweden)	• TATA Motors • TVS Motors • OPAL-RT Technologies India Pvt. Ltd. • ThoughtSpot Inc. • Urjawatt Technologies Pvt. Ltd.

TECHNOLOGY OUTREACH LINK:

http://www.linkedin.com/in/te-mobix-anrf-maha-ev-mission-445b54418

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Work Package 3.8

E-Node: IIT (BHU) Varanasi
Lead Institute: IIT (BHU) Varanasi

WORK PACKAGE: Dissemination and Communication

DISSEMINATION AND COMMUNICATION

The objective of this work package is to synthesize and disseminate project outcomes through publications, presentations, and engagement activities to reach a wide audience, including scientists, industry professionals, practitioners, and policymakers.

SUMMARY OF THE WORK PACKAGE

This work package focuses on maximizing the project's impact by synthesizing and broadly disseminating its outcomes to academia, industry, and policymakers. The team will share results via international conferences, peer-reviewed journals, regular newsletters, and a dedicated webpage. Additionally, key findings will be integrated into university course modules to educate future practitioners. Furthermore, this work package will organize targeted workshops to engage stakeholders across the EV battery ecosystem, ensuring continuous feedback and the widespread, practical application of the project's innovations.

VALUE PROPOSITION:

By leveraging the dissemination and communication strategies, this work package ensures the widespread visibility of project results, fostering knowledge exchange among academia, industry, research laboratories, and policymakers. This work package creates opportunities for feedback and MAHA-EV Te-MobiX IIT(BHU) Varanasi collaboration, ultimately supporting the adoption of project innovations.

TYPE OF END CUSTOMER

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Kharagpur • Banaras Hindu University • Institute of Chemical Technology (ICT), Mumbai • DRDO – Naval Science & Technological Laboratory (NSTL) • CSIR – National Aerospace Laboratories (NAL) • Chalmers University of Technology (Sweden) • KTH Royal Institute of Technology (Sweden)	• TATA Motors • TVS Motors • OPAL-RT Technologies India Pvt. Ltd. • ThoughtSpot Inc. • Urjawatt Technologies Pvt. Ltd.

TECHNOLOGY OUTREACH LINK:

http://www.linkedin.com/in/te-mobix-anrf-maha-ev-mission-445b54418

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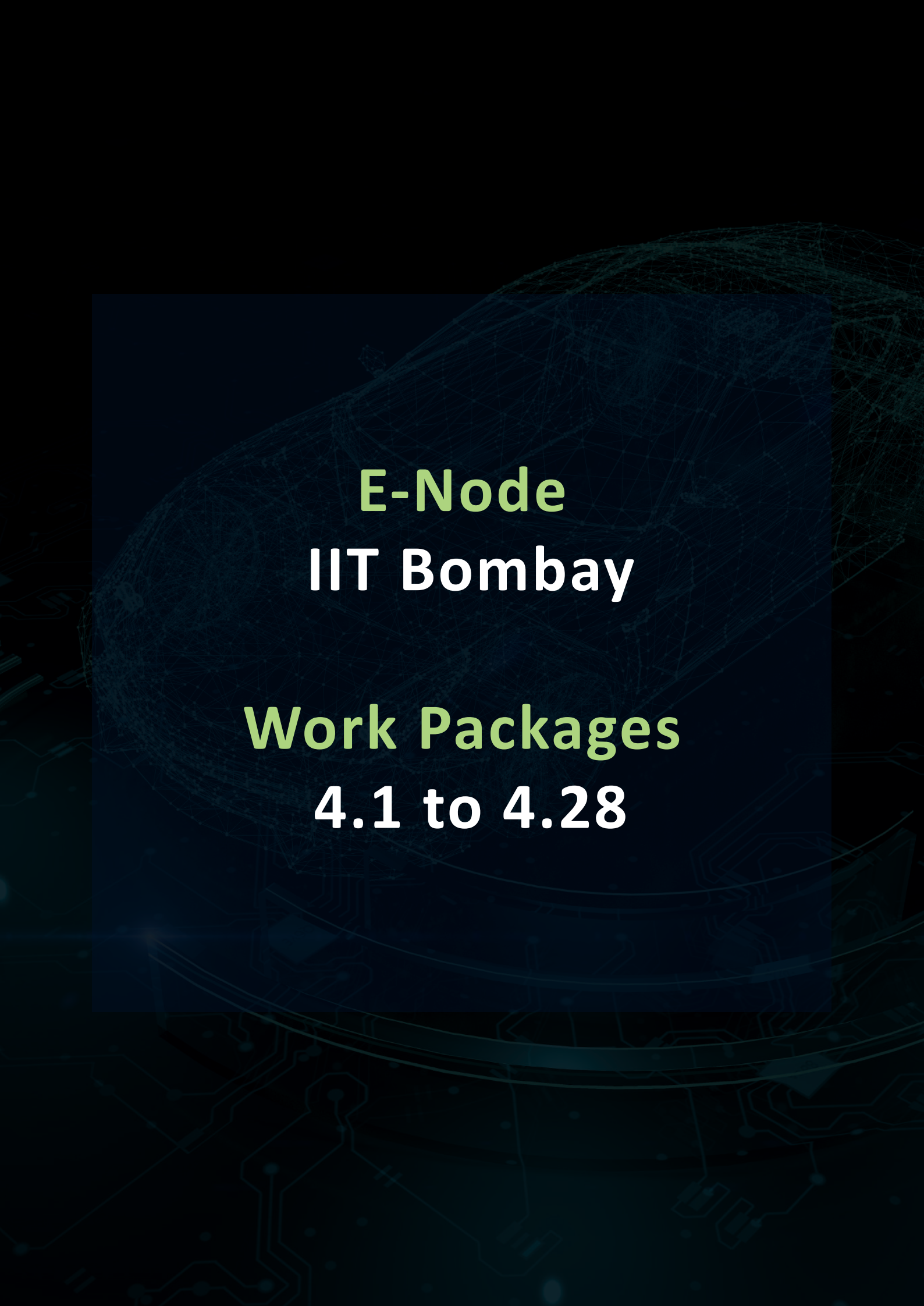


E-Node
IIT Bombay

Work Packages
4.1 to 4.28

Work Package 4.1

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Development of high power density Axial flux motors for 2/3 and 4 wheeler applications

DEVELOPMENT OF HIGH POWER DENSITY AXIAL FLUX MOTORS

This work package mainly focuses on the development of a motor with reduced or no rare earth content, thus reducing import dependencies. To achieve this, the work package mainly focuses on Axial flux topologies.

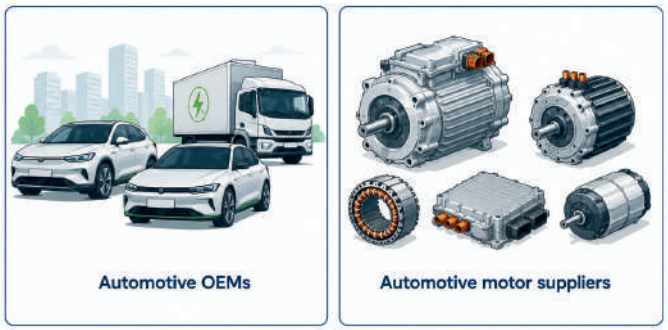
SUMMARY OF THE WORK PACKAGE

- Establish an accurate design approach for Axial Flux Machines.
- Scalable and modular designs.
- Efficiency > 90%
- Power density > 0.75 kW/kg for 2/3W motor platform
- Power density > 2 kW/kg for 4W motor platform
- Integrated motor driver solution
- Comparison with other motor technologies
- Use of reduced REPMs

VALUE PROPOSITION:

- Motors without rare earth content. Reducing import dependencies.
- Superior performance with reduced weight/volume
- High efficiency suitable for range enhancement
- Indigenized solution

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL: TRL 5-6

INSTITUTION PARTNERS: NA

INDUSTRY PARTNERS: 1

IP STATUS: NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Uno Minda Limited

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.2

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Design, Analysis and Development of stator PCB type Axial Flux PMSM for Light Electric Vehicle

PRINTED CIRCUIT BOARD BASED STATOR TYPE MOTOR DEVELOPMENT

This work package focuses on developing a compact, lightweight and energy efficient electric motor for light electric vehicles, from design to prototyping and testing.

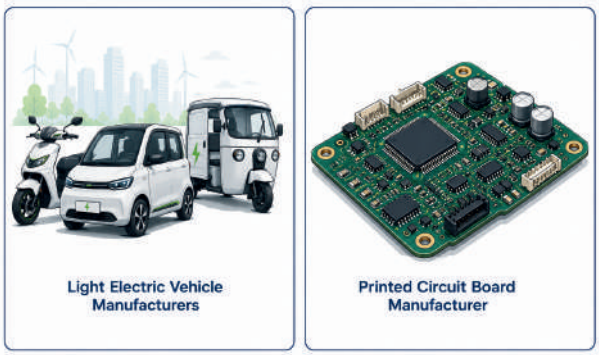
SUMMARY OF THE WORK PACKAGE

This work package focuses on developing an axial-flux motor solution for the light electric vehicle segment. For ease of manufacturability, the stators of these motors would be developed using printed circuit boards. The use of printed circuit boards enables predictable designs, better reliability, enhanced motor serviceability, and scalability. The project considers thorough indigenous design, prototyping and testing. This project delivers a compact, efficient and reliable solution that supports clean transportation, promotes innovation and enables industry collaboration.

VALUE PROPOSITION:

The developed motor offers a lightweight, compact and energy-efficient drive solution to improve vehicle performance and reduce manufacturing and operating costs. This design can serve as a scalable alternative to imported EV motors, supporting affordability, easier integration into light EVs, and enhanced reliability.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL: TRL 5

INSTITUTION PARTNERS: NA

INDUSTRY PARTNERS: 2

IP STATUS: NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• InnovateX • Hopun Innovations

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.3

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Permanent Magnet Assisted Synchronous Reluctance Motor for Electric 3-Wheeler

RARE-EARTH-FREE 3W EV MOTOR

Developing an efficient and affordable electric motor for three-wheelers using locally available magnetic materials to reduce dependence on imported rare-earth magnets.

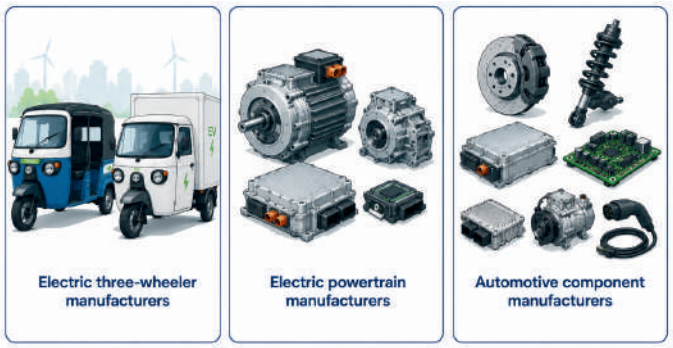
SUMMARY OF THE WORK PACKAGE

This work package focuses on developing an indigenous rare-earth-free electric motor for electric three-wheelers. Using ferrite magnets and an optimized design, the motor aims to deliver high efficiency, reliable performance, and lower manufacturing costs. The technology supports sustainable electric mobility, reduces dependence on imported materials, and strengthens India's electric vehicle manufacturing ecosystem.

VALUE PROPOSITION:

The developed motor offers a cost-effective and sustainable alternative to conventional rare-earth magnet motors. It reduces dependence on imported materials, lowers manufacturing costs, improves supply-chain resilience, and enables indigenous production. The technology delivers efficient, reliable, and high-performance electric traction suitable for electric three-wheelers and can be adapted for other electric mobility applications.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 2

INSTITUTION PARTNERS
NA

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Forvia Hella

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.4

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Electrically-excited Brushless Synchronous Motor (EEBSM) for four-wheeler

BRUSHLESS EV TRACTION MOTOR

Developing a next-generation brushless electric motor for passenger electric vehicles that delivers high performance without using rare-earth permanent magnets.

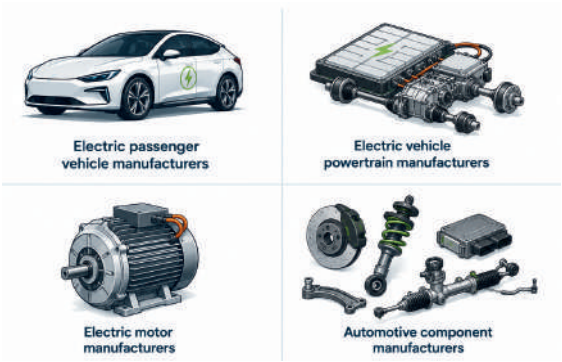
SUMMARY OF THE WORK PACKAGE

This work package focuses on developing an innovative brushless traction motor for electric passenger vehicles that operates without permanent magnets. The motor combines high efficiency, reliable operation, and reduced maintenance while minimizing dependence on imported materials. Advanced design and simulation techniques are being used to optimize performance and support the development of indigenous, sustainable electric drive technology for future electric mobility.

VALUE PROPOSITION:

The proposed technology provides a reliable and sustainable alternative to conventional permanent-magnet motors by eliminating the use of rare-earth materials. It offers lower maintenance, improved supply-chain security, and supports indigenous manufacturing, helping reduce the cost and environmental impact of future electric vehicles.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 2

INSTITUTION PARTNERS
NA

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Electra EV

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.5

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Hybrid-excited Brushless Synchronous Motor (HEBSM) for four-wheeler

HYBRID EXCITED BRUSHLESS MOTOR

Developing a hybrid excited brushless electric motor for electric vehicle auxiliary systems, capable of reliable operation under high-speed and high-temperature conditions.

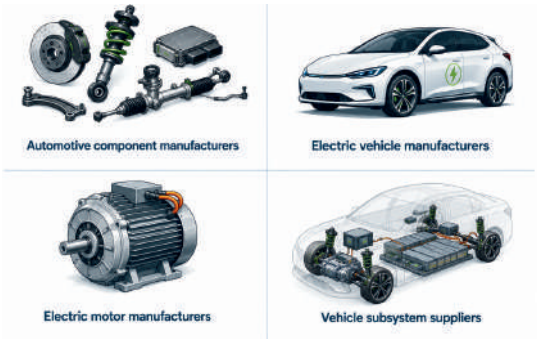
SUMMARY OF THE WORK PACKAGE

This work package focuses on developing a hybrid excited brushless motor for electric vehicle auxiliary systems. The motor combines permanent magnets with electrical excitation to achieve high efficiency, reliable operation, and reduced dependence on rare-earth materials. The design is being optimized through advanced simulations to deliver a compact, indigenous, and sustainable electric drive solution for demanding automotive applications.

VALUE PROPOSITION:

The proposed motor combines permanent magnets with electrical excitation to provide a compact, efficient, and reliable solution with reduced dependence on rare-earth materials. It supports indigenous manufacturing, offers reliable operation under demanding conditions, and enables the development of high-performance electric vehicle auxiliary systems.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 2

INSTITUTION PARTNERS
NA

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Honeywell Technology Solutions Lab Pvt. Ltd.

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.6

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Switched Reluctance Motor Based Flywheel Energy Storage System

FLYWHEEL ENERGY STORAGE SYSTEM

Developing a high-speed flywheel energy storage system to store and rapidly deliver electrical energy, improving grid reliability and supporting renewable energy integration.

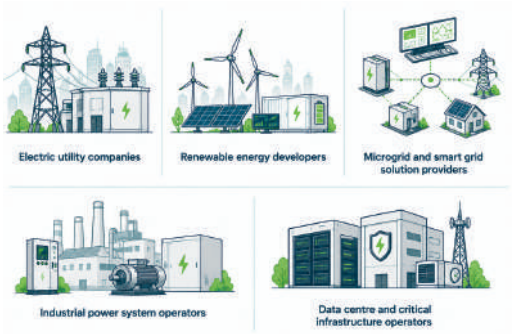
SUMMARY OF THE WORK PACKAGE

This work package focuses on developing a flywheel-based energy storage system that stores energy as rotational energy and delivers it rapidly when needed. The system is designed to improve grid stability, support renewable energy integration, and provide reliable short-duration energy storage. The motor, power converters, control system, and sensing hardware are being developed and integrated to demonstrate a robust and indigenous energy storage solution.

VALUE PROPOSITION:

The proposed flywheel energy storage system offers rapid response, long operational life, and low maintenance without relying on batteries or rare-earth magnets. It improves power quality, supports renewable energy integration, enhances grid reliability, and provides a sustainable and cost-effective solution for short-duration energy storage and grid regulation.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 3

INSTITUTION PARTNERS
NA

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Aartech Solonics Ltd.

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.7

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Design of cooling system for PMSM for Two and Three-Wheeler EV Applications

DESIGNING OF NATURAL COOLING METHOD FOR THERMAL MANAGEMENT OF TWO-THREE WHEELER EV MOTOR

Designing of natural-air cooled method which can reduce the highest temperature of BLDC motor used in two and three wheeler leads to performance improvement and extended motor life.

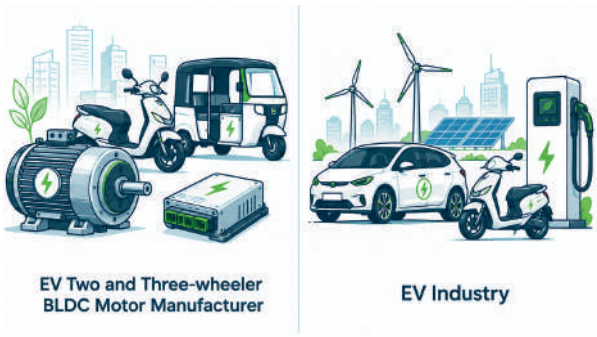
SUMMARY OF THE WORK PACKAGE

Experimental work done on locally purchased 1.5 KW BLDC motor to map its characteristics and compared it with numerically using ANSYS software. An internally placed flow guide-based cooling method proposed which has shown reduction in temperature in numerical simulation.

VALUE PROPOSITION:

A effectively thermally manged BLDC -EV motor can improve the overall performance and increase the operational life of the motor.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL: TRL 5

INSTITUTION PARTNERS: NA

INDUSTRY PARTNERS: 1

IP STATUS: NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Aether Industries Limited

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.8

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Lightweight Motor Parts for Electric Vehicles (E-RIDES)

LIGHTWEIGHT MOTOR PARTS FOR ELECTRIC VEHICLES (E-RIDES)

This work package aims at manufacturing lightweight motor parts for electric vehicles. A lighter motor ultimately means greater range per charge.

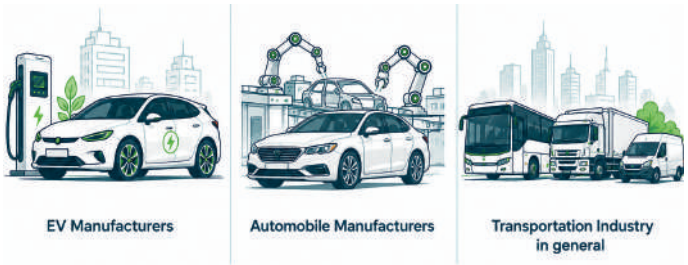
SUMMARY OF THE WORK PACKAGE

- Design and manufacture of a light weight Radial / Axial Flux Motor components
- Initially attempt to light weight stator and rotor of a small motor (a drone motor) to assess the effectiveness of light weighting strategies (completed)
- Select an EV traction motor and design light weight parts for that motor using the light weighting strategies used.
- Enhance the productivity of a number of light weight motor parts and possibly try to reduce the manufacturing cost.

VALUE PROPOSITION:

A lighter motor to drive the wheels/propeller shaft etc. It can also be a cheaper motor if a low cost manufacturing route is developed.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL: TRL 3

INSTITUTION PARTNERS: NA

INDUSTRY PARTNERS: 3

IP STATUS: NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Hindalco Industries Ltd. • Permanent Magnets Ltd. • Orange Koi Private Ltd. Vishakhapatnam

TECHNOLOGY OUTREACH LINK:

NA

CONTACT INFORMATION:

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Website Link:

Work Package 4.9

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Design and Development of 6 kW Segmented Rotor Switched Reluctance Motor and Controller for Electric 2-wheeler

SEGMENTED ROTOR EV MOTOR

Developing a compact, rare-earth-free electric motor for electric two-wheelers that delivers high performance, improved reliability, and efficient operation.

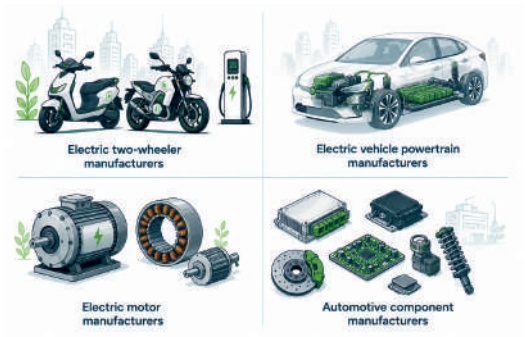
SUMMARY OF THE WORK PACKAGE

This work package focuses on developing a compact segmented rotor electric motor for next-generation electric two-wheelers. The innovative motor design aims to improve efficiency, reliability, and power density while eliminating the need for rare-earth magnets. Advanced design, simulation, and optimization are being carried out to develop an indigenous, cost-effective, and sustainable electric drive solution for India's rapidly growing electric two-wheeler market.

VALUE PROPOSITION:

The proposed motor provides a lightweight, efficient, and rare-earth-free solution for electric two-wheelers. It reduces dependence on imported critical materials, improves reliability, supports indigenous manufacturing, and offers a cost-effective electric drive technology suitable for large-scale production.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 2

INSTITUTION PARTNERS
NA

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Singla motors

TECHNOLOGY OUTREACH LINK:

NA

CONTACT INFORMATION:

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Work Package 4.10

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Modular Off-Board LEV Charger

FAST MODULAR EV CHARGER

This work focuses on developing a compact and efficient charger for light electric vehicles. It can work with both single-phase and three-phase power supplies while keeping the design simple, reliable, and easy to scale.

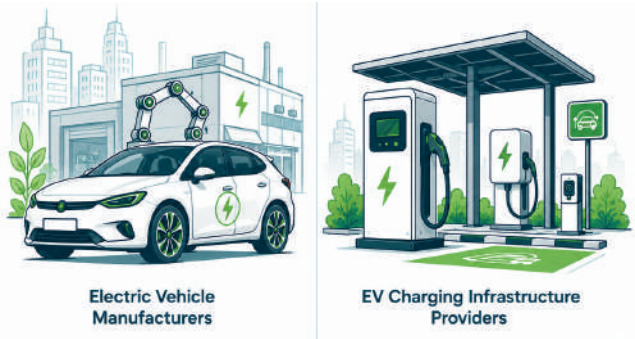
SUMMARY OF THE WORK PACKAGE

This work package focuses on developing a compact segmented rotor electric motor for next-generation electric two-wheelers. The innovative motor design aims to improve efficiency, reliability, and power density while eliminating the need for rare-earth magnets. Advanced design, simulation, and optimization are being carried out to develop an indigenous, cost-effective, and sustainable electric drive solution for India's rapidly growing electric two-wheeler market.

VALUE PROPOSITION:

The charger is compact, efficient, and easy to expand for different power levels. It uses fewer components, which helps reduce cost and improves reliability. It supports different types of light electric vehicles, making it suitable for public charging stations and future EV infrastructure.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 2-3

INSTITUTION PARTNERS
1

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay	• zenergize

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.11

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Development of 48 V Switched Reluctance Motor Drive for Electric 2-wheeler

48 V EV DRIVE SYSTEM

Developing an efficient, rare-earth-free electric drive system for electric two-wheelers using a low-voltage architecture suitable for affordable and sustainable mobility.

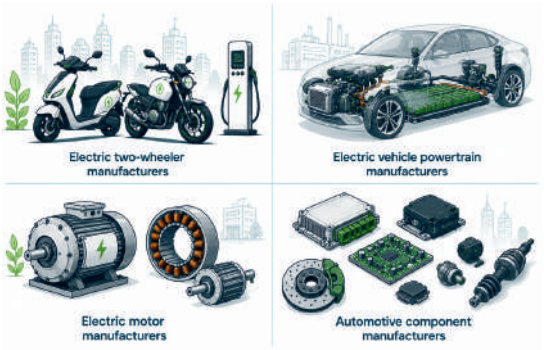
SUMMARY OF THE WORK PACKAGE

This work package focuses on developing a 48 V rare-earth-free electric drive system for electric two-wheelers. In consultation with the industry partner, the project scope has been refined to develop a Synchronous Reluctance Motor (SynRM) that delivers high efficiency, reliable operation, and cost-effective performance. The design requirements and technical specifications are currently being finalized to support the development of an indigenous electric drive solution.

VALUE PROPOSITION:

The proposed electric drive system aims to provide a compact, efficient, and cost-effective solution for electric two-wheelers without relying on rare-earth permanent magnets. It supports indigenous manufacturing, reduces dependence on imported materials, and contributes to the development of affordable and sustainable electric mobility technologies.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL: TRL 2

INSTITUTION PARTNERS: NA

INDUSTRY PARTNERS: 1

IP STATUS: NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• ROHM Semiconductor India

TECHNOLOGY OUTREACH LINK:

NA

CONTACT INFORMATION:

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Work Package 4.12

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Hotspot Avoidance in High Current Traction Inverter for Light Electric Vehicles

EFFICIENT AND RELIABLE 2-WHEELER MOTOR CONTROLLER

This work aims to develop a compact controller to power the motor in electric vehicles. The work focuses on making it reliable, energy-efficient, and capable of handling high power.

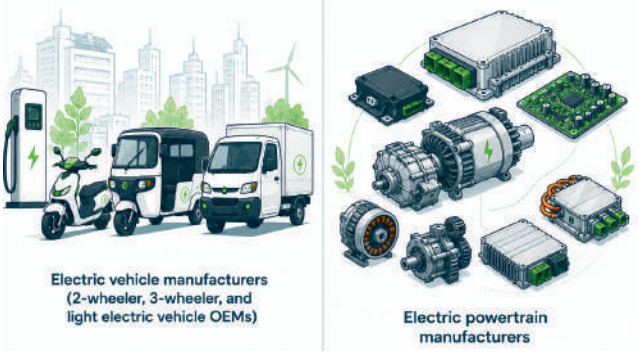
SUMMARY OF THE WORK PACKAGE

This work focuses on the development of a 72-V, 8-kW (12-kW peak) traction inverter for light electric vehicles (LEVs). The design parallel-connected Gallium Nitride (GaN) transistors for high-current operation. The key focus will be on addressing challenges such as dynamic current sharing, minimizing parasitic effects, and achieving effective thermal management. A symmetric PCB layout will minimize parasitic inductances, while PCB-embedded Rogowski coil current sensors will monitor individual device currents to dynamically regulate current sharing and mitigate thermal hotspots.

VALUE PROPOSITION:

The proposed GaN-based traction inverter tailored for light electric vehicles (LEVs) offers higher efficiency, reduced power losses, and a compact, lightweight design compared to conventional silicon-based inverters. These advantages improve vehicle range, enable better space utilization, and simplify thermal management. The enhanced efficiency reduces operating costs and extends battery utilization, providing a lower total cost of ownership for EV manufacturers. Its scalable architecture also enables adoption across a wide range of electric mobility and industrial applications.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL: TRL 2

INSTITUTION PARTNERS: NA

INDUSTRY PARTNERS: 1

IP STATUS: NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Calvem Energy Pvt. Ltd.

TECHNOLOGY OUTREACH LINK:

NA

CONTACT INFORMATION:

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Website Link: https://web.iitd.ac.in/~ssnag/

Work Package 4.13

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Unified power electronic interface (UPEI) for Light Electric Vehicles

INTEGRATED EV CHARGER WITH MOTOR CONTROL

This work package develops an integrated electric vehicle charging system that combines battery charging and motor control into a single compact platform, reducing system size, increasing efficiency, and reduce the overall cost.

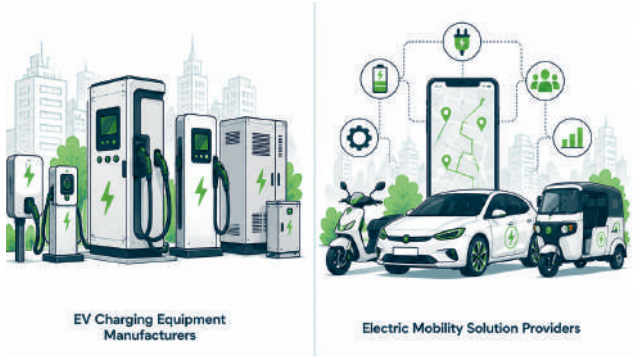
SUMMARY OF THE WORK PACKAGE

This work package focuses on developing a compact system that combines electric vehicle battery charging and vehicle drive functions into a single unit. This integrated approach reduces the number of components, reduce space, lowers manufacturing costs, and improves overall energy efficiency. The solution is designed to make electric vehicle charger more reliable, and easier to manufacture while enhancing driving performance and energy use. It supports the development of affordable, high-performance, and sustainable electric mobility solutions for future transportation needs.

VALUE PROPOSITION:

The proposed solution combines battery charging and vehicle drive functions into a single compact system, reducing the number of components, overall size, weight, and manufacturing cost. It improves energy efficiency, reliability, and ease of integration into electric vehicles. By simplifying the vehicle's charger, it helps manufacturers develop more affordable, efficient, and high-performance electric vehicles while reducing production complexity and supporting faster adoption of sustainable mobility solutions.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 3

INSTITUTION PARTNERS
1

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay	• Forvia Hella

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.14

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Design and development of a 20 kW SiC based traction inverter

ELECTRIC DRIVE TECHNOLOGY DEVELOPMENT

Design, development, and validation of a 20 kW SiC-based traction inverter for electric vehicle applications, incorporating advanced diagnostics, protection, and condition monitoring features to improve system performance, reliability, and functional safety.

SUMMARY OF THE WORK PACKAGE

This work package focuses on the design, development, and validation of an indigenous 20 kW SiC-based traction inverter for electric vehicle applications. The project includes advanced diagnostics, health monitoring, and protection features to improve system reliability, safety, and performance. A cost-effective, high-efficiency inverter platform will be developed with a control strategy compatible with rare-earth-free permanent magnet motors, supporting the Make in India initiative while reducing dependence on imported technologies and strengthening domestic EV manufacturing capabilities.

VALUE PROPOSITION:

- Indigenous technology aligned with the Make in India initiative, reducing reliance on imported traction inverter solutions.
- Reduced supply chain and geopolitical risks by minimizing dependence on foreign vendors and technology.
- Cost-effective and scalable design suitable for domestic EV manufacturers.
- Integrated diagnostics, health monitoring, and protection to improve reliability, safety, and maintainability.
- Advanced control strategy optimized for traction motors using rare-earth-free permanent magnets, enabling wider adoption of sustainable motor technologies.
- High-efficiency, high-power-density SiC-based architecture for next-generation electric vehicles.

TYPE OF END CUSTOMER

Automotive Industry

TECHNOLOGY READINESS LEVEL
TRL 6

INSTITUTION PARTNERS
1

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay	• Forvia Hella India Automotive

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.15

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Multi-functional wireless charger for LEVs with minimal on-board power electronics

WIRELESS CHARGING SYSTEM FOR LIGHT ELECTRIC VEHICLES

Developing a wireless charging solution that allows light electric vehicles to be charged safely, efficiently, and without plugging in cables.

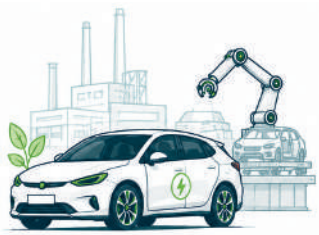
SUMMARY OF THE WORK PACKAGE

This work package aims to develop a wireless charging system for light electric vehicles, enabling battery charging without plugging in a cable. The project includes front-end power factor correction (PFC), high-frequency wireless power transfer using transmitter and receiver coils, a compact transmitter PCB with top-cooled MOSFETs, constant current and constant voltage battery charging control, system optimization, and hardware validation to develop an efficient and compact wireless charging system. The proposed solution will make EV charging more convenient and user-friendly, encouraging the wider adoption of electric mobility.

VALUE PROPOSITION:

Provides a compact, cable-free wireless charging solution that makes charging light electric vehicles easier, safer, and more convenient by eliminating the need for charging cables. The system supports safe battery charging through constant current and constant voltage control and automatically tracks the optimum leakage compensation frequency to maintain efficient charging under varying coil alignment conditions. Its compact design, enabled by top-cooled SiC MOSFETs and an aluminium backplate, reduces installation space, lowers maintenance, and supports next-generation electric mobility.

TYPE OF END CUSTOMER



Electric vehicle manufacturers

Charging infrastructure providers

TECHNOLOGY READINESS LEVEL
TRL 3

INSTITUTION PARTNERS
1

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay	• Ather Energy Limited

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.16

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bhubaneswar

WORK PACKAGE: Renewable assisted grid integrated wireless EV charging System

RENEWABLE POWERED WIRELESS EV CHARGING

This work aims to develop a convenient way to charge electric vehicles using renewable energy assisted wireless technology, making charging easier, and environmentally friendly.

SUMMARY OF THE WORK PACKAGE

This work package will develop a cable-free charging system for electric vehicles using both renewable energy and electricity from the power grid. It aims to make charging more convenient while ensuring a steady power supply. The project will help promote cleaner transportation by making electric vehicle charging easier, and suitable for everyday use.

VALUE PROPOSITION:

This proposed charging system offers electric vehicle users a more convenient, and environmentally friendly charging experience. By using clean energy along with the existing electricity network, it provides solution to range anxiety and reducing environmental impact. Its cable free design improves ease of use and supports wider adoption of electric vehicles.

TYPE OF END CUSTOMER

TECHNOLOGY READINESS LEVEL
TRL 4

INSTITUTION PARTNERS
NA

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Roadgrid India Private Limited

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.17

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: GaN-based High-Efficiency Misalignment-Tolerant Capacitive Wireless Charger for Electric Four-Wheelers

CAPACITIVE WIRELESS EV CHARGER

Wireless charging can bring convenience and autonomy in EV charging and potentially reduce battery size. The proposed capacitive charger makes the charging pads much simpler to implement and embed in roadway, and reduces cost and weight compared to traditional inductive chargers.

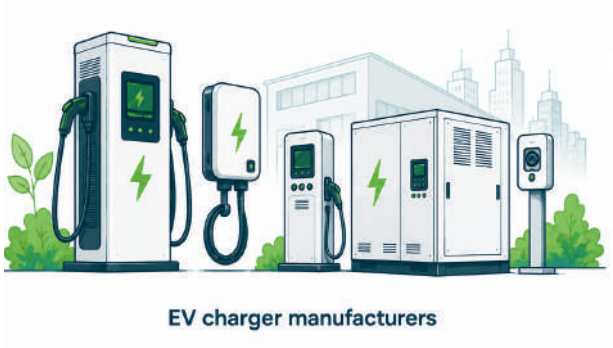
SUMMARY OF THE WORK PACKAGE

This work package focuses on building an efficient Level-II (7.2 kW) capacitive wireless charger for EVs while making the system tolerant to misalignment and safer in terms of electric field. Wireless power will be transferred across air-gaps representative of EV ground clearance using high-frequency power electronic systems and vehicle-integrable capacitive charging pad.

VALUE PROPOSITION:

- Indigenous development of GaN based MHz-frequency capacitive wireless charging system for EVs
- Alleviation of challenges related to inductive wireless chargers that requires embedding ferrite and litz wire on the roadway
- Development of an wireless power transfer technology applicable to various other applications including charging of drones

TYPE OF END CUSTOMER



EV charger manufacturers

TECHNOLOGY READINESS LEVEL
TRL 3

INSTITUTION PARTNERS
NA

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Semtronics India Private Limited

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.18

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Kanpur

WORK PACKAGE: Modular and Configurable Off-board Charger (G2V, V2G, V2V) for 4-, 3- and 2-wheelers

A CONFIGURABLE EV CHARGER FOR 4/3/2-WHEELERS

This work package aims to develop an EV charger that can be configured to charge a 4-wheeler or multiple 2- or 3-wheelers at a charging station, as needed. The proposed charger is equipped with battery backup and can operate during power outages and single-phase fault conditions, making it suitable for rural and semi-urban regions in India.

SUMMARY OF THE WORK PACKAGE

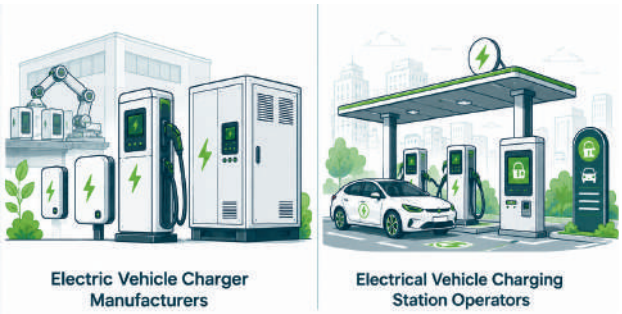
This work package aims to develop an EV charger with the following features:

- Configurable power architecture: A common DC charging solution for 2-, 3-, and 4-wheelers
- Modular power architecture: Easy inventory management, reduced cost per module during mass-scale production, facilitating scaling up to higher power and voltage levels
- Battery backup at charging stations: Keeps the charging station functional during power outages
- Phase modular architecture: Keeps the charging station functional during single-phase faults
- Bidirectional power flow: grid-to-vehicle (G2V), vehicle-to-grid (V2G), vehicle-to-vehicle (V2V)

VALUE PROPOSITION:

- 1) Configurability: The proposed charger can be configured to charge multiple 2/3-wheelers or a 4-wheeler, catering to the rural and semi-urban needs.
- 2) Fault-tolerant Operation: Single-line-to-ground (SLG) faults are quite common in rural areas. The proposed charger remains functional at a reduced power level during SLG fault scenarios.
- 3) Battery Back Up: Frequent power outages are experienced in many suburban areas, leading to idle business hours for the charging station operators. The proposed architecture allows battery charging when the grid is available. The operator can use these batteries to charge multiple 2- or 3-wheelers or a 4-wheeler during power outages.
- 4) Selling Power to the Utility: The proposed configuration facilitates power flow from batteries back to the utility grid. This enables the charging station operator to use some of the station batteries to sell power during high-tariff hours. The same facility applies to vehicle owners, since vehicle-to-grid (V2G) operation is also feasible with the proposed solution.

TYPE OF END CUSTOMER



Electric Vehicle Charger Manufacturers

Electrical Vehicle Charging Station Operators

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Amplify Mobility Private Limited (EVRE) • Texas Instruments India Private Limited • Electrohms Private Limited

TECHNOLOGY OUTREACH LINK:

https://www.linkedin.com/feed/update/urn:li:share:7374071805004742656/

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Work Package 4.19

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Design and Development of 11kV Medium -Voltage SiC based DC Fast Charger

ELECTRIC VEHICLE FAST CHARGER

Battery electric vehicles (BEVs) require compact, high-power DC fast charging infrastructure to overcome range anxiety and accelerate widespread adoption. Replacing bulky line-frequency transformers with solid-state transformer technology enables high-frequency operation, significantly reducing charger size and weight while improving power density and space utilization.

SUMMARY OF THE WORK PACKAGE

Battery electric vehicles (BEVs) offer notable environmental and economic benefits, yet limited rapid charging capability remains a key barrier to widespread adoption. While most BEV charging occurs at home, access to public DC fast chargers (50 kW–120 kW) significantly increases vehicle utility. Studies show that in regions with such infrastructure, annual electric vehicle miles traveled can rise by over 25%, even if fast charging represents only 1%–5% of total charging sessions. Conventional charging systems rely on bulky line-frequency transformers, resulting in large, heavy converters and poor space utilization. Solid-state transformers enable high-frequency operation, reducing converter size and weight while improving power density. This compact, high-power charging infrastructure will improve Space utilization and reduce Range anxiety, enhancing consumer confidence in BEV adoption.

VALUE PROPOSITION:

- An indigenously developed, compact design enabling easy transportation, installation and flexible deployment in space-constrained urban areas.
- Enables high-power charging with reduced losses and improved efficiency through medium-voltage operation.
- Supports faster charging and wider deployment, reducing range anxiety and accelerating large-scale EV adoption.

TYPE OF END CUSTOMER

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay	• NXPEC

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.20

E-Node: E-RIDES IIT Bombay
Lead Institute: SVNIT

WORK PACKAGE: Design and Development of an Efficient EV Motor Controller with Model Predictive Speed Control Strategies

ADVANCED ELECTRIC MOTOR CONTROLLER

This project develops a motor controller to enhance the performance, efficiency, and reliability of electric-vehicle motors. It enables smoother driving, faster response, and better energy utilization under different operating conditions.

SUMMARY OF THE WORK PACKAGE

This work package focuses on developing an advanced motor controller for electric vehicles using Model Predictive Speed Control. The controller is designed for PM-Assisted Synchronous Reluctance Motors and aims to improve efficiency, dynamic response, overall vehicle performance, and regenerative braking. The project includes simulation, embedded controller development, hardware implementation, laboratory validation, and prototype testing for EV motor drive applications.

VALUE PROPOSITION:

The developed controller offers improved motor efficiency, speed and torque control, faster dynamic response, and better energy utilization compared to conventional control techniques. It supports regenerative braking, reduces energy losses, and enables low-cost implementation using embedded hardware. The technology is suitable for electric two-wheelers, three-wheelers, passenger vehicles, and industrial electric drive systems.

TYPE OF END CUSTOMER

TECHNOLOGY READINESS LEVEL	INSTITUTION PARTNERS
TRL 4-5	NA

INDUSTRY PARTNERS	IP STATUS
1	NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• National Infotech

TECHNOLOGY OUTREACH LINK:

https://www.linkedin.com/posts/svnit_erides-anrf-svnit-activity-7407400186022465537-VBFj

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Work Package 4.21

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay, IIT Bhubaneswar

WORK PACKAGE: Non-invasive diagnostics and prognostics of power semiconductor devices for EV 2/3W

RELIABLE POWER ELECTRONICS FOR EVS

Reliability Assessment and Online Condition Monitoring of Power Devices in EV Controllers

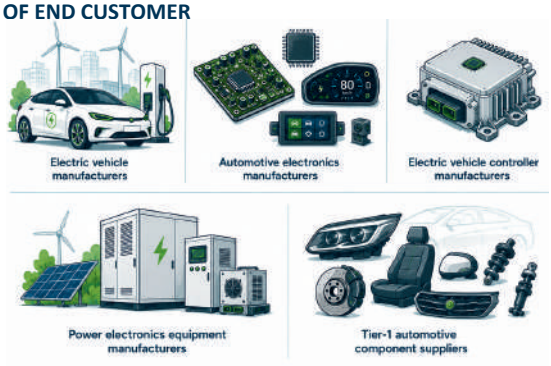
SUMMARY OF THE WORK PACKAGE

- Develop laboratory test facilities to accelerate the ageing of PSDs under electrical, thermal, and environmental conditions representative of real-world EV operation.
- Investigate the thermo-mechanical behaviour of PSDs using experiments and computational modelling to identify critical stress locations and dominant failure mechanisms.
- Identify reliable health-sensitive parameters (HSPs) that accurately indicate the degradation state and impending failure of PSDs. Development of circuits for HSPs measurement.
- Develop robust condition monitoring algorithms capable of assessing an accurate health status of PSDs.
- Integrate the sensing hardware, communication interface, and health monitoring algorithms into a unified monitoring framework for EV controllers. Validate the developed monitoring system and lifetime prediction methodology on an actual electric two-/three-wheeler controller operating under representative conditions. Establish a comprehensive reliability assessment framework that enables early fault detection, predictive maintenance, and enhanced reliability and safety of electric vehicle power electronic systems.

VALUE PROPOSITION:

The proposed technology enables health monitoring of critical power semiconductor devices used in EV controllers. It helps detect early degradation, prevent unexpected failures, improve vehicle reliability and safety, and reduce maintenance costs. The solution supports predictive maintenance by providing accurate information about component health without affecting normal vehicle operation, thereby enhancing the lifetime and dependability of EV power electronic systems.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL: TRL 3

INSTITUTION PARTNERS: 2

INDUSTRY PARTNERS: 1

IP STATUS: NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay • Indian Institute of Technology Bhubaneswar	• Ather Energy Limited

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.22

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Machine Learning Workflows for Assessing Health and Predicting Remaining Life of Power Electronics

AI BASED LIFE PREDICTION OF POWER ELECTRONICS

Development of an AI-based workflow for prediction of remaining useful life of power electronics devices and components. The tool is intended to be deployed on-the-chip for live monitoring

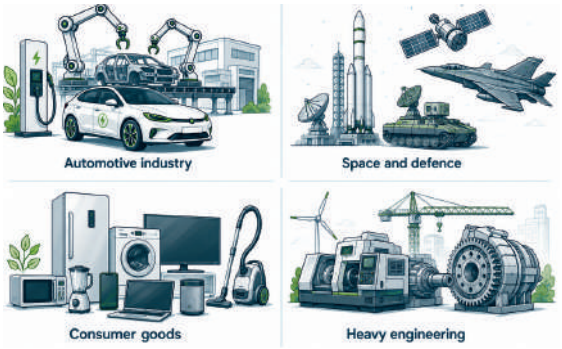
SUMMARY OF THE WORK PACKAGE

- AI based condition monitoring workflow.
- Recipe for predictive modeling of remaining life.
- Improved operating modes for the aforementioned components and systems, latent indicators for improved efficiency of vehicle.
- Dynamic (on-the-chip) health monitoring and remanent life prediction.

VALUE PROPOSITION:

It will alert the users before a breakdown. This will also add to the safety of users and machinery.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 3

INSTITUTION PARTNERS
1

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bhubaneshwar	• Forvia Hella, Pune

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.23

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Condition monitoring of Electric machines for EV and High Power Applications

MOTOR HEALTH MONITORING

Developing an intelligent monitoring system that detects faults in electric motors at an early stage, improving reliability, safety, and operational life.

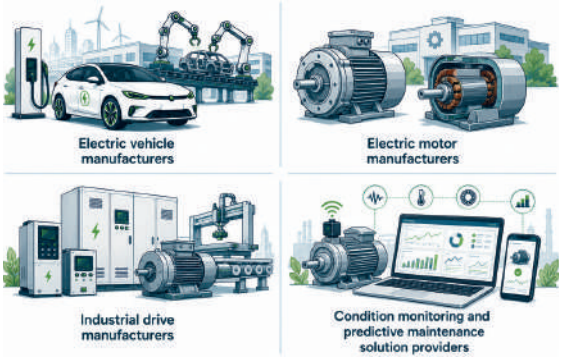
SUMMARY OF THE WORK PACKAGE

This work package focuses on developing an intelligent condition monitoring system for electric motors used in electric vehicles and high-power applications. Advanced signal analysis and simulation techniques are being used to identify early signs of motor faults, enabling timely maintenance and preventing unexpected failures. The technology aims to improve system reliability, reduce maintenance costs, and enhance the operational life of electric drive systems.

VALUE PROPOSITION:

The proposed technology enables early detection of motor faults without requiring additional sensing hardware. It helps reduce unexpected failures, lowers maintenance costs, improves reliability and safety, and extends the operational life of electric motors. The solution can also be integrated into existing motor drive systems, making it suitable for both new installations and retrofit applications.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 2

INSTITUTION PARTNERS
NA

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Ather Industries Limited

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.24

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Gandhinagar

WORK PACKAGE: Smart Battery Safety and Performance Optimization

ADVANCED BATTERY HEALTH AND PERFORMANCE ENHANCEMENT

The work package focuses on the generation of battery datasets and the development of lightweight battery digital twins. Additionally, the work explores strategies for extending battery life while ensuring battery safety.

SUMMARY OF THE WORK PACKAGE

Laboratory-standard experimental datasets, involving time and frequency domain testing, of lithium-ion batteries and sodium-ion batteries are being collected. Furthermore, digital twins for battery health monitoring are developed employing our lab-generated dataset and existing heterogeneous datasets. These lightweight BMS-compatible health testing tools strengthen the real-time reliable battery-charger communication, setting the base for next-gen health-aware charging strategies. In this context, an adaptive health-aware charging strategy is devised. Furthermore, the designed in-house 'Battery Abuse Test Setup' is under testing to comprehend the mechanisms of thermal runaway for safe battery operation.

VALUE PROPOSITION:

The developed technologies/techniques are expected to increase the adoption rate of battery-based systems by ensuring safety and optimal performance:

- Laboratory-generated battery datasets would facilitate the advancement of current battery research.
- Developed lightweight digital twins for battery state of health estimation enable real-time health monitoring, thereby enhancing operation reliability and alleviating range anxiety.
- Devised health-aware charging protocol prolongs battery life, diminishing the probability of internal short circuits and thermal runaway caused by lithium plating.

TYPE OF END CUSTOMER

TECHNOLOGY READINESS LEVEL
TRL 3-4

INSTITUTION PARTNERS
1

INDUSTRY PARTNERS
1

IP STATUS
2 filed

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• The Automotive Research Association of India (ARAI)	• Enphase Energy

TECHNOLOGY OUTREACH LINK:

https://electricvehicletalks.com/iitgns-ai-tool-to-predict-and-prevent-ev-fires/

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Work Package 4.25

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Advanced Battery Management Systems: SoC Estimation, Balancing, and Indigenous Development for Enhanced Performance

SMART BATTERY STATUS TRACKER

This update adds a smart health-tracking feature directly to the battery's microchip. It allows the chip to instantly read complex battery signals and accurately predict its lifespan, each cell temperature and performance.

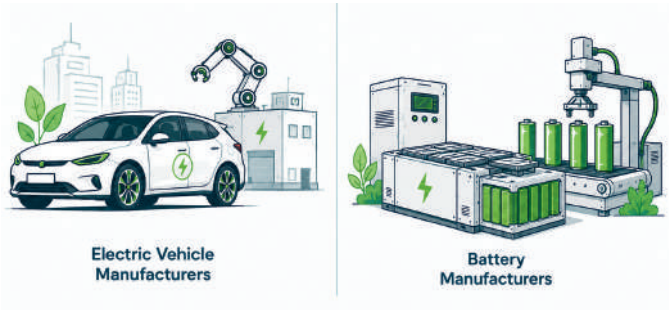
SUMMARY OF THE WORK PACKAGE

This work package integrates an advanced embedded diagnostics and estimation framework directly onto the battery management system's host microcontroller. By processing sparse physical data locally on the hardware, the chip executes physics-informed thermal mapping to reconstruct a full real-time cell-level temperature profile. Simultaneously, it extracts discrete electrochemical aging features to compute the battery's exact State of Health (SoH) and remaining useful life. This eliminates reliance on cloud telemetry or high-cost edge-AI hardware, and optimizes overall pack safety and performance

VALUE PROPOSITION:

Our technology gives electric vehicle and battery manufacturers accurate, real-time battery health and temperature monitoring without adding any new hardware. Running entirely on the low-cost microchips already inside the battery pack, it eliminates expensive AI processors and cloud connectivity, cutting cost per vehicle. Manufacturers gain instant, precise State of Health and temperature estimates, enabling safer packs, longer warranties, and better resale value, all through a simple software upgrade to the existing Battery Management System.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL: TRL 3

INSTITUTION PARTNERS: NA

INDUSTRY PARTNERS: 2

IP STATUS: NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Revine Technologies Limited, Ahmedabad • ElectraEV, Pune

TECHNOLOGY OUTREACH LINK:

https://www.instagram.com/p/DSZ9IGNjMPF/

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Work Package 4.26

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: Integrated, high reliability SiC power modules for next generation electric vehicle power electronics

HIGH PERFORMANCE POWER ELECTRONICS FOR ELECTRIC VEHICLES

This work develops compact and reliable power modules that improve the efficiency, performance, and durability of electric vehicle traction systems.

SUMMARY OF THE WORK PACKAGE

The objective of the work package is to design a 1200 V, 100 A SiC half-bridge power module featuring planar interconnects and integrated gate-drivers. This includes design and evaluation of multiple layouts for optimised electrical performance, better thermal management and reliability. Prototype development and experimental validation will be performed to demonstrate glitch-free switching and robust thermal performance under real-world electric vehicle operating conditions.

VALUE PROPOSITION:

- High Efficiency: Reduced electrical (switching) losses, improving the overall efficiency of traction power converters.
- Compact Design: Reduces converter size, weight, and cooling requirements, enabling compact power electronic systems.
- Reliable Operation: Ensuring stable operation and extended service life under required traction conditions.
- Better Thermal Management: Improved heat dissipation supports higher power density and enhances reliability.

TYPE OF END CUSTOMER

Automotive Industry

TECHNOLOGY READINESS LEVEL	TRL 3
INSTITUTION PARTNERS	1
INDUSTRY PARTNERS	1
IP STATUS	NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Bombay	• MacDermid Alpha

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.27

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: **Design, fabrication and testing of PCB-embedded packaging for next-gen, high-frequency, on-board EV power electronics**

PCB-EMBEDDED PACKAGING FOR POWER ELECTRONICS

Preliminary work related to the optimization of the electroplating process has started. Mask layout is completed along with plating of metallic structures. Electroplating is needed to attach chips on PCB.

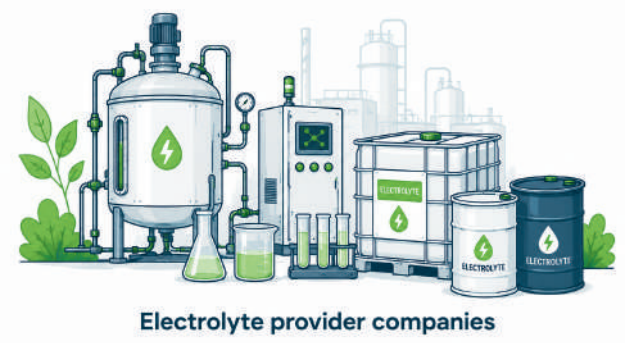
SUMMARY OF THE WORK PACKAGE

This work package aims to develop and demonstrate the PCB-embedded packaging for next-gen, high-frequency, on-board EV power electronics. Chip will be attached to thick copper film and will be embedded using polyamide film. Later, metallization will be used to create interconnects.

VALUE PROPOSITION:

Successful validation of the pilot prototypes will create PCB-embedded packages with bare dies without having to execute the complex fabrication process themselves, which will be outsourced to specialized indigenous PCB manufacturers like PCB Power.

TYPE OF END CUSTOMER



Electrolyte provider companies

TECHNOLOGY READINESS LEVEL
TRL 3

INSTITUTION PARTNERS
NA

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• MacDermid Alpha

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 4.28

E-Node: E-RIDES IIT Bombay
Lead Institute: IIT Bombay

WORK PACKAGE: **Impact Assessment**

EMISSIONS IMPACT ASSESSMENT OF EV TRANSITION

This work package examines the environmental impact of India's EV transitions through a cross-sectoral (industry, power, transport) and cross-regional analysis of EV carbon and air pollution emissions. First, we develop a novel component- and process-wise emission factors database, and second, we use this database to assess the emission impacts of different EV policy scenarios. Through the scenario analyses, we intend to inform evidence-based policymaking for an equitable EV transition in India.

SUMMARY OF THE WORK PACKAGE

- To Construct India-specific, regionally disaggregated emission factor dataset of vehicle manufacturing and adoption processes
- To Develop database of marginal emission factors for India's electricity grid, to assess spatio- temporal variations in EV charging emissions
- To Design scenarios to assess changes in CO2 and air pollutant emissions and its health impacts
- To inform decision-making on EV transition in India by conducting a comprehensive emissions impact assessment so that maximum benefits, in terms of GHG mitigation and air quality & health improvement, can be realised

VALUE PROPOSITION:

To provide robust decision support for India's EV transition by designing a range of future scenarios and systematically assessing their emissions impacts in a holistic manner, with the aim of identifying pathways that maximize GHG mitigation while also delivering substantial improvements in air quality and public health outcomes.

TYPE OF END CUSTOMER

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• NA

TECHNOLOGY OUTREACH LINK:

NA

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E-Node
IIT Kanpur

Work Packages
5.1 to 5.5

Work Package 5.1

E-Node: IIT Kanpur
Lead Institute: IIT Kanpur

WORK PACKAGE: Grid integration of EV charging infrastructure

POWER INFRASTRUCTURE FOR ELECTRIC MOBILITY

This work package aims to develop practical solutions for deploying and operating EV charging infrastructure at scale. It addresses reliable power supply, efficient charging management, renewable energy integration, battery utilization, and secure digital operation of charging networks.

SUMMARY OF THE WORK PACKAGE

This work package focuses on making EV charging reliable, efficient, and ready for large-scale adoption. It develops practical solutions for planning where charging stations should be installed, managing their day-to-day operation, integrating renewable energy, and using EV batteries to support the electricity system when needed. The work also includes real-time monitoring of charging infrastructure, improving user experience, reducing operational costs, and ensuring that charging networks remain safe, secure, and resilient against digital threats.

VALUE PROPOSITION:

This work package delivers practical solutions that enable reliable, scalable, and cost-effective deployment of EV charging infrastructure. It helps utilities, charging operators, and policymakers improve planning, reduce operational costs, integrate renewable energy, enhance charging reliability, strengthen digital security, and create a future-ready charging ecosystem that supports India's transition to sustainable electric mobility.

TYPE OF END CUSTOMER

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Madras • National Institute of Technology Durgapur • National Institute of Technology Warangal • IIITDM Jabalpur • Indian Institute of Technology Delhi	• ChargeQ Technologies • Ray-D-US Renewable • Nayak Power Systems • OPAL-RT Technologies

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 5.2

E-Node: IIT Kanpur
Lead Institute: IIT Delhi

WORK PACKAGE: Development of low-power EV charging infrastructure

CHARGING FOR 2W, 3W AND 4W EVS

This work package focuses on making EV charging simple, accessible, and convenient for all types of electric vehicles, including two-wheelers, three-wheelers, and cars. It develops indigenous modular charging solutions, portable charger, and efficient battery swapping technologies to improve user experience and accelerate EV adoption.

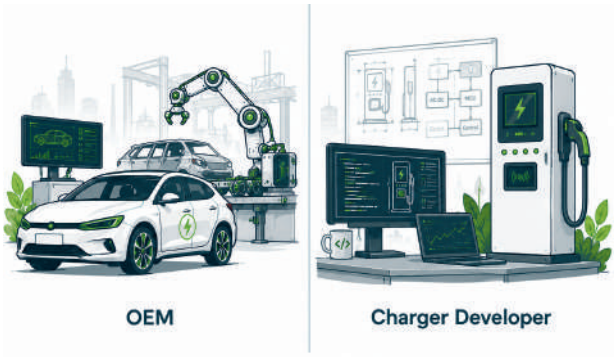
SUMMARY OF THE WORK PACKAGE

This work package aims to develop convenient and accessible charging solutions for all categories of electric vehicles, including two-wheelers, three-wheelers, and cars. It focuses on enabling a common charging experience through universal modular charging interfaces, portable charger, smart energy management, and efficient battery swapping solutions. The major focus is on start-to-end ownership of indigenous converter hardware development with circuit selection, design, simulation, prototyping, and validation. The work will improve compatibility among different EV models, reduce charging complexity, enhance battery utilization, and provide reliable services for EV users. The outcomes will support wider EV adoption by creating affordable, user-friendly, and scalable charging solutions suitable for homes, workplaces, and public charging locations.

VALUE PROPOSITION:

This work package enables convenient, affordable, and inclusive EV charging by developing solutions that support multiple vehicle types through a common charging ecosystem. It reduces charging complexity, improves accessibility, and enhances the user experience through universal charging interfaces, smart charging management, and efficient battery-swapping technologies. The outcomes will help charging operators reduce infrastructure requirements, support wider EV adoption, and accelerate the transition toward sustainable and accessible electric mobility.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 5-6

INSTITUTION PARTNERS
3

INDUSTRY PARTNERS
NA

IP STATUS
1 Granted
1 Filed

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Delhi • Indian Institute of Technology Roorkee • Indian Institute of Technology Kharagpur	• NA

TECHNOLOGY OUTREACH LINK:

NA

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Website Link:

Work Package 5.3

E-Node: IIT Kanpur
Lead Institute: IIT Delhi

WORK PACKAGE: Development of high-power EV charging infrastructure

MAKING COMPACT, EFFICIENT, INDIGENOUS HIGH POWER EV CHARGER

This work package develops compact, reliable, and indigenous high-power EV charging technologies that reduce charging time, improve user convenience, and enable large-scale deployment of electric mobility.

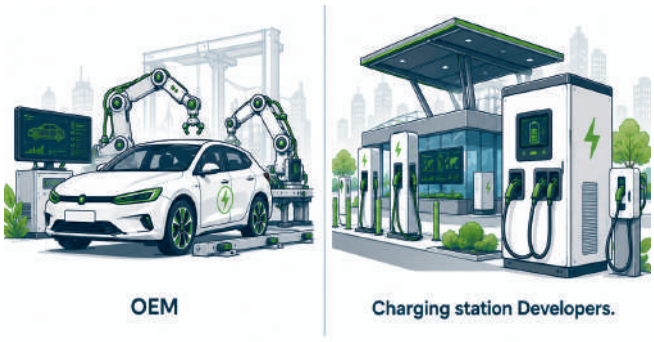
SUMMARY OF THE WORK PACKAGE

This work package focuses on developing next-generation fast charging solutions that make EV charging quicker, more efficient, and easier to deploy. It covers high-speed wired charging, wireless charging, and advanced power systems that reduce charging time, improve energy efficiency, and support a wide range of electric vehicles, from passenger cars to buses and commercial vehicles. The work includes the design, development, testing, and demonstration of indigenous charging technologies in collaboration with industry partners. The expected outcomes are compact, reliable, scalable, and cost-effective charging solutions that accelerate EV adoption while supporting India's growing electric mobility ecosystem.

VALUE PROPOSITION:

This work package enables the widespread adoption of electric vehicles by making charging faster, more accessible, and more dependable. The technologies developed will strengthen India's charging ecosystem, reduce dependence on imported technologies, encourage domestic innovation and manufacturing, and provide the foundation for a reliable, future-ready charging infrastructure.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL
TRL 6

INSTITUTION PARTNERS
1

INDUSTRY PARTNERS
2

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• CDAC Thiruvananthapuram	• Uniper Energy Systems • Simactricals Pvt. Ltd

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 5.4

E-Node: IIT Kanpur
Lead Institute: TERI

WORK PACKAGE: Policy interventions and social inclusion

BUILDING AN INCLUSIVE EV FUTURE, EV MOBILITY AND POLICY

This work package supports a fair and inclusive shift to electric mobility by engaging communities, preparing the workforce, and strengthening policies for the future.

SUMMARY OF THE WORK PACKAGE

This work package promotes an inclusive and sustainable transition to electric mobility by increasing public awareness, improving access to electric vehicles for underserved communities, building workforce skills, and developing supportive policies. It brings together communities, industry, utilities, and policymakers to address social, economic, and infrastructure challenges, ensuring that the benefits of electric mobility are accessible to everyone while preparing the power system and workforce for the growing adoption of electric vehicles

VALUE PROPOSITION:

This work package delivers practical solutions that make electric mobility more accessible, affordable, and inclusive for citizens, businesses, and policymakers. It helps communities adopt EVs with confidence through awareness, skill development, accessible mobility solutions, and supportive policies. By improving workforce readiness and enabling better planning for EV integration, it creates long-term social, economic, and environmental benefits while ensuring a reliable and equitable transition to sustainable transportation.

TYPE OF END CUSTOMER

TECHNOLOGY READINESS LEVEL
TRL 4

INSTITUTION PARTNERS
1

INDUSTRY PARTNERS
NA

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• TERI	• NA

TECHNOLOGY OUTREACH LINK:

https://www.linkedin.com/feed/update/urn:li:activity:7462103520872349696

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Work Package 5.5

E-Node: IIT Kanpur
Lead Institute: TERI

WORK PACKAGE: Field Deployment

VALIDATION AND DEMONSTRATION OF EV CHARGING INFRASTRUCTURE

This work package validates and demonstrates the technologies developed in the project under real-life conditions before large-scale deployment. It ensures that the solutions are reliable, practical, and ready for adoption by users and industry.

SUMMARY OF THE WORK PACKAGE

This work package focuses on testing and validating the EV charging technologies, control systems, and grid integration solutions developed in the project. The technologies will first be evaluated in a controlled laboratory environment using real-time testing platforms and then deployed on campus microgrids to assess their performance under actual operating conditions. The feedback obtained from these demonstrations will be used to further improve the solutions and enhance their readiness for commercial deployment.

VALUE PROPOSITION:

Provides field-validated, reliable, and deployment-ready EV charging and grid integration solutions that reduce technical risks, improve system reliability, enable faster commercialization, and support cost-effective deployment of EV charging infrastructure. The validation platform also helps stakeholders confidently adopt new technologies with proven real-world performance.

TYPE OF END CUSTOMER

TECHNOLOGY READINESS LEVEL
TRL 6

INSTITUTION PARTNERS
3

INDUSTRY PARTNERS
NA

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• IIITDM Jabalpur • National Institute of Technology Durgapur • TERI	• NA

TECHNOLOGY OUTREACH LINK:

NA

CONTACT INFORMATION:

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E-Node
IIT Kharagpur

Work Packages
6.1 to 6.4

Work Package 6.1

E-Node: IIT Kharagpur
Lead Institute: IIT Kharagpur

WORK PACKAGE: Renewable Energy Integrated High Power Charger with direct interface to MV Grid

DC FAST CHARGER FOR ELECTRIC VEHICLE

This work package will develop an indigenous next-generation DC fast charging solution for electric vehicles, including passenger cars, SUVs and commercial vehicles. The proposed direct MV interfaced charging technology will make the chargers more efficient compared to existing charging solutions which will result in increased reduction in carbon dioxide emissions. They will also require less space enabling more number of charging stations to come up in congested cities. Integration of renewable energy sources will load on the electricity supply system and will make charging more affordable. With these technological improvements the technology is expected to play a pivotal role in accelerating the transition toward widespread electric vehicle adoption.

SUMMARY OF THE WORK PACKAGE

Objectives

Design and develop 4 laboratory prototypes of Solid State Transformer (SST)-based DC fast chargers rated at 2x25 kW, 200V-950V DC with direct interface to 1.1 kV supplies and solar PV. Identify the most suitable charging converter topology for both small-scale and large-scale charging parks. Develop an integrated IC design to make chargers more compact and power-dense. Scale up recommended topologies to a pilot prototype at the 2x250 kW power level for direct integration into the 11 kV grid.

Deliverables

On completion of the project, four dual-gun 2x25 kW laboratory prototypes, validated simulation models, and final recommendations for high-power charging topologies will be available. In addition, 3–4 patents will be filed and 8–10 international journal papers will be published.

VALUE PROPOSITION:

The proposed chargers will be compact and will save expenditure on real estate for Public EV Charging Infrastructure Companies. Being more efficient they will reduce electricity consumption (about 25000 units per year per charger) and hence will save on the running cost. If they pass on a portion of this saving to the Fleet Operators, Public Transport Agencies the later will benefit from reduced charging cost. On the other hand if Fleet Operators and Public Transport Agencies establish their own captive charging stations they will also benefit from reduced installation and running cost similar to the Public EV Charging Infrastructure Companies. They will also acquire carbon credit due to reduced carbon dioxide emission.

TYPE OF END CUSTOMER

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners

- Indian Institute of Technology Bhubaneswar
- National Institute of Technology Hamirpur
- Visvesvaraya National Institute of Technology, Nagpur
- National Institute of Technology Durgapur

Industry Partners

- Megatherm Induction Limited
- Lab Concern India
- Reliance Storage Energy & Systems
- Esskay Enterprises
- Syngient Technologies
- Trellisign Technologies
- Dynolt Technologies Pvt. Ltd.
- SFO Technologies Ltd.
- Galaxy International Ltd.

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 6.2

E-Node: IIT Kharagpur
Lead Institute: BIT, Mesra

WORK PACKAGE: **Design and development of High power density Static wireless charger**

WIRELESS FAST CHARGER FOR ELECTRIC VEHICLES

This work package will develop an indigenous next-generation wireless fast-charging solution for electric vehicles, including passenger cars and SUVs, capable of achieving charging times of 30 minutes to 1 hour. The proposed contactless charging technology will redefine the EV charging experience by enabling effortless, safe, and highly convenient energy transfer without physical connectors. By enhancing user convenience and reducing charging barriers, the technology is expected to play a pivotal role in accelerating the transition toward widespread electric vehicle adoption.

SUMMARY OF THE WORK PACKAGE

Develop an indigenous 50 kW wireless fast charging system for electric vehicles operating at 100 kHz. The project will improve charging performance by reducing the effects of coil misalignment, controlling electromagnetic interference, and managing heat effectively. It will also include a smart monitoring and control system for reliable operation. By eliminating physical contact between the vehicle and the charger, the system will provide a safer, more convenient charging experience and encourage wider adoption of electric vehicles.

VALUE PROPOSITION:

The proposed 50 kW wireless fast charging platform offers a safe, convenient, and cable-free charging experience for electric vehicles. It enables fast charging in 30–60 minutes, reduces maintenance by eliminating connector wear, and improves safety by avoiding physical electrical contacts. Smart monitoring and control ensure reliable operation, while seamless charging enhances vehicle availability and user convenience. The platform supports commercial fleets, public charging infrastructure, and future autonomous mobility, accelerating the adoption of electric vehicles.

TYPE OF END CUSTOMER

TECHNOLOGY READINESS LEVEL
TRL 3

INSTITUTION PARTNERS
1

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Birla Institute of Technology, Mesra	• Megatherm Induction Limited

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 6.3

E-Node: IIT Kharagpur
Lead Institute: IIT Kharagpur

WORK PACKAGE: Economic Analysis and Dynamic Charge Pricing

ECONOMIC ANALYSIS AND DYNAMIC CHARGE PRICING

The goal is to develop algorithms for the efficient operation of a high-power grid-connected electric vehicle charging station with on-site renewable generation and storage via dynamic charge pricing for customers.

SUMMARY OF THE WORK PACKAGE

This work package focuses on the economic analysis and dynamic pricing of renewable integrated EV charging stations. First, it aims to evaluate capital investments, operational expenditures, and revenue streams. The main technical component involves designing a dynamic pricing scheme to maximizing the revenue of a single station via stochastic optimization under highly uncertain demand, followed by designing a spatially heterogeneous pricing scheme for a network of charging stations to minimize urban traffic and grid congestion.

VALUE PROPOSITION:

This work package will develop a charging management system (CMS) software to maximize profitability and operational efficiency for EV charging stations through data-driven planning and smart dynamic pricing. By optimizing local PV generation and battery storage, it aims to reduce electricity procurement costs during peak hours. Additionally, its spatially-heterogeneous pricing aims to mitigate grid and traffic congestion while minimizing customer waiting times, transforming standard charging stations into highly profitable, efficient, and grid-friendly infrastructure hubs.

TYPE OF END CUSTOMER

TECHNOLOGY READINESS LEVEL: TRL 3

INSTITUTION PARTNERS: 1

INDUSTRY PARTNERS: 1

IP STATUS: NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Ather Energy • Calcutta Electric Supply Corporation (CESC) Limited

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 6.4

E-Node: IIT Kharagpur
Lead Institute: IIT Kharagpur

WORK PACKAGE: Study and Mitigation of the effects of charging stations on the grid

STUDY AND MITIGATION OF THE EFFECTS OF CHARGING STATIONS ON THE GRID

The goal is to analyse the congestion in create and other power quality issues on the distribution network due fast and ultra fast chargers and provide the mitigation strategies, at both planning and operation stage.

SUMMARY OF THE WORK PACKAGE

This work package focuses on the economic analysis and dynamic pricing of renewable integrated EV charging stations. First, it aims to evaluate capital investments, operational expenditures, and revenue streams. The main technical component involvesThis work package investigates the impact of fast-charging stations on the power distribution network, focusing on voltage stability, power quality, harmonic distortions, and fault levels. It aims to develop optimal placement and operational planning of EVs to reduce the network stress, advanced control frameworks, real-time energy management systems, and adaptive protection schemes for renewable-integrated electric vehicle charging stations. Furthermore, it explores leveraging these stations to provide ancillary grid services, such as frequency response and voltage regulation, ensuring a resilient and reliable power grid designing a dynamic pricing scheme to maximizing the revenue of a single station via stochastic optimization under highly uncertain demand, followed by designing a spatially heterogeneous pricing scheme for a network of charging stations to minimize urban traffic and grid congestion.

VALUE PROPOSITION:

This work package provides solutions that will equip utility companies and infrastructure operators with advanced tools to mitigate grid stress caused by fast chargers. Integrating real-time energy management systems and adaptive protection schemes allows operators to enhance power quality, minimize harmonic distortions, and improve grid stability. Furthermore, it enables charging stations to generate new revenue by participating in ancillary grid services, ensuring safe and efficient energy distribution while managing the demands of increasing electric vehicle adoption.

TYPE OF END CUSTOMER

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• NA	• Calcutta Electric Supply Corporation (CESC) Limited • Tata Power Company Limited

TECHNOLOGY OUTREACH LINK:

NA

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E-Node
NITK Surathkal

Work Packages
7.1 to 7.3

Work Package 7.1

E-Node: NITK Surathkal
Lead Institute: NITK Surathkal

WORK PACKAGE: Magnet-free three-wheeler drive

MAGNET-FREE THREE-WHEELER DRIVE

Designing, optimising and validating a rare-earth-free switched reluctance motor and its controller for electric two- and three-wheelers, from simulation and multiphysics studies through hardware prototype testing.

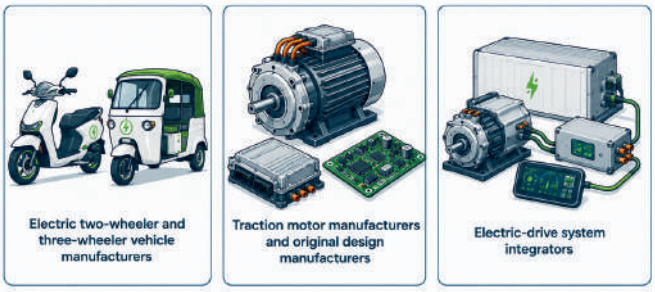
SUMMARY OF THE WORK PACKAGE

This work package delivers a complete rare-earth-free switched reluctance motor for electric three-wheelers. Focuses on motor design, making it robust and compact, using advanced simulations to improve noise, vibration, and thermal performance. It also covers developing the motor controller and printed circuit boards (PCBs), building and assembling prototypes, and testing the system on dynamometer platforms under conditions similar to real vehicle operation.

VALUE PROPOSITION:

Offers a fully localisable, rare-earth-free traction drive path for high-volume Indian two- and three-wheelers, cutting magnet cost and import risk. Virtual multiphysics optimisation plus measured prototype data reduces technology risk for manufacturers needing proven torque, efficiency, noise and durability before pilot production, supporting Make in India manufacturing of EV motors.

TYPE OF END CUSTOMER



TECHNOLOGY READINESS LEVEL: TRL 5

INSTITUTION PARTNERS: 1

INDUSTRY PARTNERS: 4

IP STATUS: NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• National Institute of Technology Karnataka, Surathkal	• Aditya Auto Products & Engineering (India) Private Limited • Aditya Avartan Technologies Private Limited • Brevera Technologies Private Limited • Nexsys Controls Private Limited

TECHNOLOGY OUTREACH LINK:

NA

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Work Package 7.2

E-Node: IIT Madras - CDAC Thiruvananthapuram
Lead Institute: IIT Madras - CDAC Thiruvananthapuram

WORK PACKAGE: **Rare-earth magnet-free axial-flux motor and SiC controller, Industrial Iron Waste Derived Motor Core Material Developement**

AXIAL-FLUX MOTOR, CONTROLLER AND CORE MATERIAL FOR MOTORS

Developing a compact ferrite-assisted axial flux motor together with a matching high-efficiency silicon-carbide-based controller for electric two-wheelers, without rare-earth permanent magnets, a core for motors processed from industrial iron waste, which is superior in performance and increases efficiency.

SUMMARY OF THE WORK PACKAGE

This work package develops a complete rare-earth-magnet-free axial-flux motor-drive system for electric 2-wheelers, together with high-performance motor core materials produced from industrial iron waste, while also designing the ferrite-assisted axial-flux motor, developing a high-efficiency silicon-carbide (SiC) controller, engineering and processing the motor core material, electromagnetic, thermal and mechanical design, prototype fabrication and assembly, and comprehensive testing to validate efficiency, power density, reliability, and overall system performance.

VALUE PROPOSITION:

Combining sustainable motor core materials with a rare-earth-magnet-free axial-flux motor and high-efficiency SiC controller enables compact, efficient, and cost-effective electric drives for two-wheelers. The use of industrial iron waste creates high-performance motor core materials while reducing material costs and environmental impact. Together, these technologies improve power density, efficiency, manufacturability, and supply-chain resilience, supporting scalable and locally sourced electric mobility solutions.

TYPE OF END CUSTOMER

TECHNOLOGY READINESS LEVEL
TRL 5-6

INSTITUTION PARTNERS
2

INDUSTRY PARTNERS
2

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

Institute Partners	Industry Partners
• Indian Institute of Technology Madras • CDAC, Thiruvananthapuram	• Lucas TVS Limited • Semtronics India Private Limited

TECHNOLOGY OUTREACH LINK:

NA

CONTACT INFORMATION:

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भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

Work Package 7.3

E-Node: IIT Hyderabad
Lead Institute: IIT Hyderabad

WORK PACKAGE: **High-speed current-source inverter traction drive for high-power EV**

CURRENT-SOURCE HIGH-POWER EV DRIVE

Developing a high-speed current-source inverter traction drive for higher-power electric vehicles, reducing reliance on short-life electrolytic capacitors.

SUMMARY OF THE WORK PACKAGE

This work package develops a high-speed current-source inverter traction drive as an alternative to conventional voltage-source inverter drives for higher-power electric vehicles. The work includes system design and simulation, developing advanced control methods for reliable operation of multiphase motors, designing the power converter and control hardware using wide-bandgap devices, integrating protection features, testing the drive on a motor test setup, and evaluating its efficiency, power density, and overall performance to establish practical design guidelines.

VALUE PROPOSITION:

This technology offers a more reliable and compact traction drive for higher-power electric vehicles by reducing the need for short-life electrolytic DC-link capacitors. It also has the potential to improve efficiency, reduce electromagnetic interference, lower motor stress and thermal loading, and increase system reliability, making it a promising alternative to conventional voltage-source inverter drives.

TYPE OF END CUSTOMER

TECHNOLOGY READINESS LEVEL
TRL 5

INSTITUTION PARTNERS
2

INDUSTRY PARTNERS
1

IP STATUS
NA

PARTNER INSTITUTES AND INDUSTRIES

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