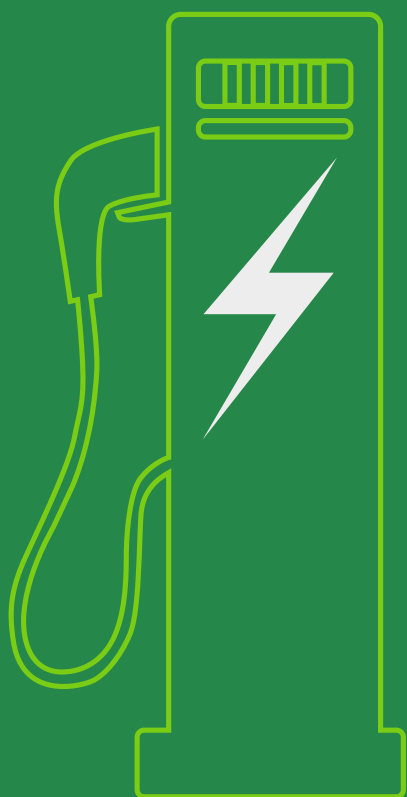
REPORT

# ACCELERATING EV TRANSITION:

## Enabling an EV-Ready Facility at DECPL, Chhatrapati Sambhajinagar

# ACCELERATING EV TRANSITION: ENABLING AN EV-READY FACILITY AT DECPL CHHATRAPATI SAMBHAJINAGAR



# ACCELERATING EV TRANSITION: ENABLING AN EV-READY FACILITY AT DECPL CHHATRAPATI SAMBHAJINAGAR

A Technical Report Submitted by

WRI INDIA

as a part of

*Enabling an Equitable EV Transition for MSMEs in Maharashtra project in collaboration with Deogiri Electronics Cluster Pvt. Ltd. (DECPL)*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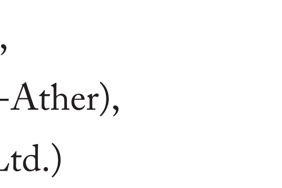

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LIST OF ABBREVIATIONS

CSN ................ Chhatrapati Sambhajinagar
MSME ........... Micro, Small and Medium Enterprises
DECPL .......... Deogiri Electronics Cluster Pvt. Ltd.
CFC ................ Common Facility Center
EV ................... Electric Vehicle
OEMs ............. Original Equipment Manufacturers
ICE ................. Internal Combustion Engine
AURIC ........... Aurangabad Industrial City
ACMs ............. Auto Component Manufacturers
NATRIP ......... National Automotive Testing and R&D Infrastructure Project

CHAPTER 1

# PROJECT RATIONALE AND CONTEXT

The change toward electric mobility offers Maharashtra's auto and component industries a chance to diversify beyond conventional technologies. For MSMEs in Chhatrapati Sambhajinagar, this shift requires access to modern infrastructure. Deogiri Electronics Cluster Pvt. Ltd. (DECPL), as a Common Facility Centre (CFC), is well-placed to support this shift. This research study has been done to define the set of manufacturing tools, machinery, and testing infrastructure required under one roof for EV powertrain production.

## 1.1. Objective of the Study

The objective of this study is to develop a clear, actionable roadmap for upgrading the existing infrastructure of Deogiri Electronics Cluster Private Limited (DECPL) in Chhatrapati Sambhajinagar (CSN), aligning it with the fast-evolving needs of EV component manufacturing. With the increasing electrification of mobility and the emergence of new Original Equipment Manufacturers (OEMs) in the region, the study seeks to ensure that MSMEs and EV-focused startups are equipped with the right tools, machinery, and capabilities to remain competitive and integrate into the EV value chain.

The core outcome is a stakeholder-validated recommendation of precise tooling and equipment—drawn from consultations with current DECPL users, prospective MSMEs, and EV domain experts—that will transform DECPL into a future-ready Common Facility Centre (CFC) for EV powertrain component manufacturing.

## 1.2. Significance of Common Facility Centres (CFCs) for MSME Competitiveness

Common Facility Centres (CFCs) are shared industrial facilities designed to support MSME clusters by offering access to advanced equipment, testing services, training, and R&D. For MSMEs that lack the capital to independently invest in modern machinery, a CFC acts as a cost-effective enabler of competitiveness.

In the context of EV manufacturing, where the requirements for tooling and technology are rapidly evolving, a strategically upgraded CFC can become a central platform for experimentation, low-volume prototyping, and production support. By reducing the risk and cost of transition, CFCs empower MSMEs to participate in future value chains.

The transition from internal combustion engine (ICE) vehicles to electric vehicles (EVs) is reshaping the entire automotive supply chain. EVs require fewer moving parts but demand new components like electric motors, battery packs, power electronics, and thermal management systems. This shift makes many traditional powertrain ICE components obsolete, while opening opportunities in emerging domains.

For MSMEs, the challenge lies in pivoting toward these new sub-assemblies. This requires new tooling (e.g., winding machines for stators, battery module assembly lines, inverter testing rigs), high-precision machining, and access to relevant technical standards — all of which a modernized CFC can support.

However, the lack of EV-aligned infrastructure and training remains a significant hurdle. A fit-for-purpose CFC can fill this void by providing shared access to precision manufacturing equipment, electronics assembly lines, and part-testing facilities, thus closing the readiness gap for local MSMEs and startups.

## 1.3. Why Chhatrapati Sambhajinagar (CSN)?

Chhatrapati Sambhajinagar, once renowned for its textiles and sugar mills, has, over the past three decades, matured into a powerhouse of precision engineering. Today, it is one of Maharashtra's foremost precision-engineering hubs. The region boasts 1,648 registered Auto Component Manufacturers (ACMs), ranging from small fabrication shops to mid-sized stamping and gearbox producers, and sustains a formal workforce of over 30,631 skilled employees.[1] Two legacy OEMs such as Bajaj Auto and Škoda Auto anchor the cluster. At the same time, major Tier-1 suppliers such as Endurance Technologies, Varroc, Rucha Engineers, NRB Bearings, Badve Engineering, Aurangabad Electricals, and Greaves Cotton have built deep local supply chains for critical components.[2]

This established set of infrastructure has created not only scale but also a concentration of specialised skills– CNC machining, metal stamping, heat treatment, and precision assembly–that underpin the cluster's competitive advantage. Through decades of incremental modernisation, local MSMEs have mastered cost-effective production of ICE sub-assemblies such as gearboxes, engine mounts, and sheet-metal components. Yet the very strengths that built the cluster–UIIstandardized processes, tooling for mechanical parts, and supply agreements with ICE OEMs must now adapt to the electrification wave sweeping the automotive sector.

With the development of Aurangabad Industrial City (AURIC), a 10,000-acre greenfield smart industrial zone in the Shendra-Bidkin Industrial Area (SBIA) developed under the Delhi–Mumbai Industrial Corridor (DMIC) framework.[3] AURIC's infrastructure—dedicated power, water treatment, logistics connectivity, and plug-and-play factory plots—has attracted large manufacturing units. Beyond mere expansion, AURIC represents a strategic pivot: from legacy ICE supply chains toward high-tech manufacturing, advanced materials, and, most notably, EV components.

The SBIA region attracted several high-profile EV projects such as: Reliance Infrastructure plans a ₹14,377 crore EV unit[4]; Ather Energy is setting up a ₹2,000 crore two-wheeler assembly plant[5] ; JSW Green Mobility has procured 636 acre land and proposed a ₹27,200 crore facility with an estimated 20,000 direct and indirect jobs[6] and Toyota Kirloskar is investing ₹20,000 crore which is expected generate 16,000 jobs.[7] These investments will diversify the cluster's industrial base, creating demand for precision-electrical sub-assemblies (motors, inverters, battery modules) alongside existing mechanical components.

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[1] *iFOREST. (2024, April). Maharashtra automobile report. International Forum for Environment, Sustainability & Technology. Retrieved from https://iforest.global/wp-content/uploads/2024/04/Maharashtra-Automobile-Report.pdf*

[2] *Government of Maharashtra. (n.d.). Chhatrapati Sambhaji Nagar industrial profile. Maharashtra Industry, Trade and Investment Facilitation Cell (MAITRI). Retrieved from https://maitri.maharashtra.gov.in/wp-content/uploads/pdf/Chh%20Sambhaji%20Nagar.pdf*

[3] *National Industrial Corridor Development Corporation. (n.d.). Aurangabad Industrial City (AURIC), Maharashtra. Retrieved from https://nicdc.in/projects/4-projects-developed/aurangabad-industrial-city-auric-maharashtra*

[4] *Times of India. (2024, April 19). Chief Minister Devendra Fadnavis says over Rs 28,000 crore fresh investment likely at Aurangabad Industrial City. Retrieved from https://timesofindia.indiatimes.com/city/aurangabad/chief-minister-devendra-fadnavis-says-over-rs-28000-crore-fresh-investment-likely-at-aurangabad-industrial-city/articleshow/119549694.cms*

[5] *Economic Times. (2024, June 29). Ather's Rs 2,000 crore electric scooter plant to come up in Maharashtra's Sambhajinagar: Devendra Fadnavis. Retrieved from https://economictimes.indiatimes.com/industry/renewables/athers-rs-2000-crore-electric-scooter-plant-to-come-up-in-maharashtras-sambhajinagar-devendra-fadnavis/articleshow/111290389.cms?from=mdr*

[6] *Economic Times. (2024, October 3). JSW Green Mobility gets 636-acre land to set up manufacturing plant. ET Auto – The Economic Times. Retrieved from https://manufacturing.economictimes.indiatimes.com/news/automotive/jsw-green-mobility-gets-636-acre-land-to-set-up-manufacturing-plant/114134343*

[7] *Business Standard. (2024, July 31). Toyota to explore a greenfield plant in Aurangabad. Retrieved from https://www.business-standard.com/companies/news/toyota-to-explore-a-greenfield-plant-in-aurangabad-124073101393_1.html*

The shift toward high-tech and electric-mobility manufacturing brings unique opportunities for local auto component manufacturers (ACMs) and MSMEs. To capitalize on this wave, these enterprises must simultaneously modernise their technology, upgrade workforce skills, and bolster production capabilities. Chhatrapati Sambhaji-nagar with its deep roots in traditional manufacturing and its influx of new-age EV investments is the ideal centerpiece for this transformation. By equipping DECPL with a plug-and-play CFC facility that encompasses the entire EV manufacturing value chain under one roof, we can leverage the region's legacy strengths while empowering local ACMs and MSMEs to lead India's electric-mobility revolution. In doing so, CSN will not only preserve its manufacturing leadership but also pioneer India's shift to electric mobility. These investments will diversify the cluster's industrial base, creating demand for precision-electrical sub-assemblies (motors, inverters, battery modules) alongside existing mechanical components.ing local ACMs and MSMEs to lead India's electric-mobility revolution. In doing so, CSN will not only preserve its manufacturing leadership but also pioneer India's shift to electric mobility. These investments will diversify the cluster's industrial base, creating demand for precision-electrical sub-assemblies (motors, inverters, battery modules) alongside existing mechanical components.

## CHAPTER 2

# APPROACH AND METHODOLOGY

This research study adopted a multi-pronged approach, comprising desk research; focused consultations with current DECPL users, prospective MSMEs, and EV startups; and collaboration with experts from India's leading EV manufacturers to develop a technical equipment mapping—ensuring our recommendations for DECPL were both market-relevant and technically rigorous.

**FIGURE 2. 1: |** Approach & Methodology Flowchart

**Approach & Methodlogy**

**Secondary Research:**
Conducted a comprehensive review of literature and sectoral reports to map EV powertrain manufacturing requirements for the proposed CFC, and benchmarked global Common Facility Centres (CFCs) through cross-sectoral secondary research and analysis.

**Primary Research:**
Engaged industry domain experts to define module-wise manufacturing processes, identify equipment requirements, and assess DECPL's procurement needs, resulting in a recommended list of machines and tools with indicative costs and estimated lead times.

**Validation of Technical Inputs:**
Held focused consultations with DECPL members and startups to validate findings, capture real-world operational needs, and refine the recommendations accordingly.

## 2.1. Secondary Research

The study began by establishing a comprehensive baseline understanding of EV powertrain manufacturing requirements and by surveying whether any existing CFC facilities in India or globally offer end-to-end support—from research & development and testing through to component manufacturing. It followed mixed methods approach with combination of both primary and secondary data sources. An extensive literature review of industry reports, OEM supplier manuals, and government policies catalogued core processes, component specifications, and testing standards for electric motors, inverters, and battery modules etc.

At the same time, several literature sources were examined to understand such facilities in different sectors—spanning textile and electronics—and benchmark lessons on their operational usage, technological advancements, and training modules. These insights were then organized into a detailed matrix mapping each process step to its recommended equipment (for example, "motor winding→ automatic coil winder →precision ±0.1 mm"), along with typical investment ranges, procurement vendors, manpower requirements for operation, and lead times. Building on this foundation and previous survey experience, a focused questionnaire was crafted for individual consultations with relevant stakeholders, capturing their requirements, current facility usage, desired technological advancements, access to training, and transition barriers faced by local MSMEs and startups.

## 2.2. Primary Research (Including Technical Expert Consultations)

The equipment-mapping exercise began with individual consultations with three experts who have worked in some of the leading EV companies across the world, who helped translate stakeholder needs into a precise breakdown of the powertrain's core modules—electric motor systems, power electronics (inverters and converters), and battery-pack assemblies. For each module, the team delineated the essential manufacturing and testing steps—stator winding, rotor balancing, PCB soldering, thermal cycling, and cell formation—then identified the specific fixtures, tools, and machines required at every stage. Where DECPL already possessed compatible assets, the mapping noted retrofit potential; otherwise, it specified new procurements. Each piece of equipment was profiled with its key specifications (tolerances, power ratings, throughput), an indicative cost and lead-time estimate, and the operator skill set needed for efficient use.

**TABLE 2.2. 1** | List of Technical Experts Consulted

| S.NO | CONSULTED PERSON | DESIGNATION |
|---|---|---|
| 1. | **Mr. Mahesh Padmanabh** | Head-Electrical System |
| 2. | **Mr. Pradeep Ramanathan** | Director, Device Software Span IO, ex Tesla, ex Ather |
| 3. | **Mr. Pranay Rebala** | VP - Product & Engineering, BluJ Aerospace Pvt. Ltd. |

## 2.3. Validation Of Technical Inputs Through Stakeholder Consultations

A focused stakeholder consultation was conducted to ground the study in real-world needs. Building on insights from our earlier Bill of Materials workshop, we identified a representative set of participants—including current DECPL members, EV startups already using the facility, and prospective users seeking R&D support or scaled production capabilities. Four targeted consultation sessions were held (detailed in below table), during which participants reviewed preliminary findings on the technical discussion, shared their operational challenges, and articulated specific equipment and service requirements. The stakeholder consultations validated our technical discussion with the domain expert on the equipment-mapping framework. Throughout these sessions, stakeholders provided invaluable feedback on our proposed interventions; their suggestions have been incorporated into the recommendations of the report.

**TABLE 2.2. 2** | List of Consulted Stakeholders

| S.NO | ENTERPRISE NAME | CONSULTED PERSON | DESIGNATION |
|---|---|---|---|
| 1. | **Dopar Energy Private Limited** | Mr. Hrushabh Jadhav | Co-Founder & CTO |
| 2. | **Manu Electricals** | Dr. Vinayak Deolankar | Director, Manu Electricals Pvt Ltd |
| 3. | **QARGOS** | Mr. Alok Das | Founder |
| 4. | **Liger Mobility** | Mr. Ambadas Satav | Operations Head |

**CHAPTER 3**

# RECOMMENDATIONS FOR EV-ALIGNED UPGRADATION OF DECPL

## 3.1. Assessment Of Existing Infrastructure[8]:

Deogiri Electronics Cluster Pvt. Ltd. (DECPL) operates as a multi-faceted facility with dedicated zones for electronics manufacturing, prototyping, and design/testing, providing the basis for a potential move into electric vehicle (EV) component manufacturing. Its electronics facility is equipped for PCB prototyping and small-batch production: it hosts an automated surface mount technology (SMT) line that includes screen printers, reflow ovens, chip mounters, wave soldering equipment, and related accessories. The cluster includes PCB prototype and manufacturing capabilities, such as CNC machines, shearing, electroplating, HASL, and drilling equipment. DECPL also houses equipment for manual insertion, rework, and lead shaping, as well as ESD-safe material handling systems and workstations. The environmental and testing rooms are well-equipped, including environmental chambers, vibration testing, salt spray chambers, and thermal cycling sets.

The facility's mechanical prototype and cabinet assembly processes include CNC turret punching, press brakes, fiber laser cutting, and powder coating. Infrastructure like power backup systems, compressed air supply, ERP connection, and trained assembly workstations are also available.

## 3.2. Equipment Identified For Technological Advancement

The assessment of existing DECPL facility highlighted the center possesses foundational capabilities in machining, fabrication, and PCB assembly, it falls short in several critical domain that is a building block for the support of next-generation EV powertrain manufacturing. As electric mobility components required higher precision, tighter tolerances, and advanced testing environments, the current setup does not fully align with the technical and scale of operation required for modern EV companies or MSMEs suppliers.

For instance, while coil winding machines are available, they are primarily suited for small transformers or conventional motor coils and not supplemented with larger stator winding presses or magnetisation rigs essential for building full-scale EV motors. Based on a review of its existing equipment at the center and insights gathered through stakeholder consultations, key equipment gaps and technological needs were identified. A detailed list of the equipment is presented in the following section.

## 3.3. Recommended EV Manufacturing Tools And Machines: Cost, Lead Time & Implementation Strategy

Based on the insights gathered through extensive secondary research, a baseline understanding of EV power-train manufacturing requirements, and focused technical consultations with domain experts, a comprehensive list of recommended equipment has been developed. These tools and machines have been identified as critical for bridging existing infrastructure gaps at DECPL and for enabling broader participation of MSMEs in EV component production. The equipment outlined addresses key bottlenecks across electric motor systems, battery-pack assemblies, and control electronics, while also aligning with the evolving demands of EV manufacturing.

The following section presents detailed recommendations, including indicative costs, procurement lead times, manpower requirements, and a phased implementation strategy.

[8] *Deogiri Electronics Cluster Pvt. Ltd. (n.d.). Facilities. Retrieved from https://www.decpl.co.in/facilities.html*

**TABLE 2.2. 3** | Recommended List of Tools and Machines for EV Components Manufacturing

| COMPONENT | EQUIPMENT/ FIXTURE | SPECIFICATIONS | TESTS PERFORMED/ PURPOSE | RECOMMENDED SUPPLIER | COST ( INR, W/O GST) | DELIVERY TIME (WEEKS) | OPERATOR SKILL LEVEL |
|---|---|---|---|---|---|---|---|
| **Cell and Battery** | **Cell Cycler - Cylindrical** | 80 Channels, 5V, 25A, Programmable | 1. Characterisation test - DCIR, SOC vs OCV<br>2. Capacity test - Different C rates<br>3. Performance test - Temp vs C-rate, DSG and CHG<br>4. Aging test - wLife cycle, SOH degradation<br>5. Elevated temperature tests | Neware | 3,500,000 | 12 | MEDIUM |
| | **Cell Cycler - Pouch** | 40 Channels, 5V, 150A Programmable | 1. Characterization test - DCIR, SOC vs OCV<br>2. Capacity test - Different C rates<br>3. Performance test - Temp vs C-rate, DSG and CHG<br>4. Aging test - Life cycle, SOH degradation<br>5. Elevated temperature tests | Neware | 7,000,000 | 12 | MEDIUM |
| | **Cell Cycler with thermal chamber** | 32 Channels, 5V,150A and -40degC to 60degC, Programmable | Measure and Monitor temperatures during the test | Neware | 5,700,000 | 10 | MEDIUM |
| | **DAQ** | 19 Channels, 10V, 15A and -40degC to 800degC, Programmable | Measure Voltage, Current and Temperature throughout the test | Keithley | 525,000 | 4 | MEDIUM |
| | **Battery cycler** | 4 Channel, 60V, 100A, CAN | 1. Capacity test<br>2. Performance test - Temp vs C-rate, DSG and CHG<br>3. Aging test - Life cycle, SOH degradation<br>4. Elevated temperature tests<br>5. Drive Profile tests | Neware | 1,100,000 | 5 | MEDIUM |
| | **Battery cycler** | SL1730A , 1000V, 300A, CAN | 1. Capacity test<br>2. Performance test - Temp vs C-rate, DSG and CHG<br>3. Aging test - Life cycle, SOH degradation<br>4. Elevated temperature tests<br>5. Drive Profile tests | Scienlab | 40,000,000 | 12 | MEDIUM |
| | **EV Charging Analyzer** | SL1047A Charging Test System | Perform charger identification and compatibility testing of charging interfaces of vehicles in compliance with CCS or other standards | Scienlab | - | 12 | MEDIUM |
| | **Bidirectional power supply - 120 KW** | 1000V, 400A, Programmable | 1. Functionality test<br>2. Performance Test | Ainou | 15,000,000 | 8 | LOW |

| COMPONENT | EQUIPMENT/ FIXTURE | SPECIFICATIONS | TESTS PERFORMED/ PURPOSE | RECOMMENDED SUPPLIER | COST ( INR, W/O GST) | DELIVERY TIME (WEEKS) | OPERATOR SKILL LEVEL |
|---|---|---|---|---|---|---|---|
| **Cell and Battery** | **Battery Analyser** | 4-wire, 3mOhms-3Ohms, 6-1000Vdc, 600Vac, 500Hz, 600 V CAT III | Functionality test | Fluke/ HIOKI | 212,000 | 6 | LOW |
| | **BMS-HIL tester** | 200 Channel, 10V, 15A,6K-39KOhms, CAN, 61/2 digit Internal DMM | 1. Functionality<br>2. Safety tests<br>3. Integration test | Comemso / Scienlab | 40,000,000 | 10 | **HIGH** |
| | **Environmental chamber** | -40 to 100degC, 600L Volume, ramp rate 5degC/min | 1. Functionality test<br>2. Performance test<br>3. Characterization test<br>4. Child part level tests<br>at different temperature and Humidity | Envisys | 1,700,000 | 8 | LOW |
| | **Oven** | 4-wire, 3mOhms-3Ohms, 6-1000Vdc, 600Vac, 500Hz, 600 V CAT III | Functionality test | Fluke/ HIOKI | 212,000 | 6 | LOW |
| | **Hi-pot tester** | 6KV, leakage current measurement | Safety test | Scientific | 114,000 | 3 | LOW |
| | **MSO / MDO Oscilloscope** | 3 Series MDO, 4 Analogue, 100 MHz, 2.5 GSPS | Functionality test | Tektronix | 700,000 | 4 | MEDIUM |
| | **PCAN** | Isolated, CAN | All test | PEAK Systems | 22,000 | 2 | MEDIUM |
| | **Thermal shock chamber** | -65°C to +150°C, ramp rate 3-7degC/min, complied to IEC 60068 | Thermal shock test | Envisys | 3,650,000 | 10 | LOW |
| | **Dust test chamber** | 600L, complied to IEC 60529 | Dust test | Envisys | 1,200,000 | 10 | LOW |
| | **Vibration - Shaker Chamber** | 6000Kgf, 100g acceleration, 3" displacement, 1m/s velocity, 2100+ resonance, 1m*1m table | 1. Vibration<br>2. Shock | Scienlab | - | 12 | MEDIUM |
| | **Rain shower test chamber** | Flow rate : 14-16 L/min to 288 cu m/hr, pressure 80-150 kPa, temperature max 80°C ±5°C | Rain shower test | Envisys | 1,150,000 | 10 | LOW |
| | **Salt spray test chamber** | 600L, max 98% RH, 40-80degC, Air pressure 0.7 kg/cm$^2$ to 1.2 kg/cm$^2$, pH 6.5 to 7.2 | Salt spray test | Envisys | 800,000 | 10 | LOW |

| COMPONENT | EQUIPMENT/ FIXTURE | SPECIFICATIONS | TESTS PERFORMED/ PURPOSE | RECOMMENDED SUPPLIER | COST ( INR, W/O GST) | DELIVERY TIME (WEEKS) | OPERATOR SKILL LEVEL |
|---|---|---|---|---|---|---|---|
| **Cell and Battery** | **Test Fixtures** | MS material, orientation as per vehicle | all tests | Brisk | 200,000 | 3 | LOW |
| **Motor & Controller** | **Dynamometer Rig - 2W** | 1. Motor Speed: 0 ~ 9000 RPM<br>2. Torque Sensor: 0 ~ 50 Nm<br>3. Bidirectional DC Power supply: 80V/300A/10Kw<br>4. Power Analyzer: 8Channel, 18bit, 1500V, 2000A<br>5. AC/DC Current Probe: 1000A, DC to 1.5MHz<br>6. DC Load bank: 900V DC / 30A / 27Kw<br>7. AC Resistive Load bank: 41V RMS max & 300A Max (Each Phase)<br>8. DAQ (Data Acquisition System) : 20Channel Module, 6.5digit DMM, 22bit | 1. Output Characteristics<br>2. DC 70 Profile test<br>3. Continuous Power test<br>4. Peak Power test<br>5. Efficiency Mapping<br>6. Speed characteristics<br>7. Net Power test at Max setting voltage<br>8. Back EMF value<br>9. Thermal Stability | 40 | 13,000,000 | 16 | **HIGH** |
| | **Dynamometer Rig - 4W** | 1. Motor Speed: 0 ~ 20000 RPM<br>2. Torque Sensor: 0 ~ 500 Nm/ 0 ~ 1000 Nm<br>3. Bidirectional DC Power supply: 1000V/300A/200Kw<br>4. Power Analyzer: 8Channel, 18bit, 1500V, 2000A<br>5. AC/DC Current Probe: 1000A, DC to 1.5MHz<br>6. DAQ (Data Acquisition System): 20Channel Module, 6.5digit DMM, 22bit<br>7. 3 phase power analyser: 4 channel voltage + 4 channel current + RPM | 1. Power characterization<br>2. DC 70 Profile test<br>3. Continuous Power test<br>4. Peak Power test<br>5. Efficiency Mapping<br>6. Speed characteristics<br>7. Net Power test at Max setting voltage<br>8. Back EMF value | | | | |
| | **Torque sensor** | 0-5Nm, 5-100Nm, Contact measurement (In-line), Ethernet | 1. Performance test<br>2. Algo test<br>3. Functionality test<br>4. Characterisation test | NCTE | 315,000 | 8 | LOW |
| | **Tachometer** | 0-9000rpm, Contact measurement (In-line), RS 232 | 1. Performance test<br>2. Functionality test | Fluke | 33,000 | 4 | LOW |
| | **DMM/ DAQ** | 19 Channels, 10V, 15A and -40degC to 800degC, Programmable | Measure Voltage, Current and Temperature throughout the test | Keithley | 525,000 | 4 | MEDIUM |

| COMPONENT | EQUIPMENT/ FIXTURE | SPECIFICATIONS | TESTS PERFORMED/ PURPOSE | RECOMMENDED SUPPLIER | COST ( INR, W/O GST) | DELIVERY TIME (WEEKS) | OPERATOR SKILL LEVEL |
|---|---|---|---|---|---|---|---|
| **Motor & Controller** | **Motor Controller HIL** | 4 channel 1000V, 300A power HIL system | 1. Perform functional verification of control stage<br>2. Simulate various scenarios for acceleration, traction loss, 4WD etc | Opal RT / DV | | | **HIGH** |
| | **Motor Simulator** | 41V RMS line-line, Power Factor of 0.8A at 400Hz, operating frequencies 0-700Hz | 1. Functionality test<br>2. Performance test<br>3. Characterization test | Retrack | 395,000 | 12 | LOW |
| | **Bidirectional power supply - 15 KW** | 80V, 200A, Programmable | 1. Functionality test<br>2. Performance Test | EA | 1,700,000 | 5 | LOW |
| | **cRIO - Chassis and modules** | Real time computing, 0-60V Multifunction module - DI, DO, AI and AO, -10 to 200degC measurement card | all tests | NI | 2,000,000 | 12 | **HIGH** |
| | **Test Fixtures** | MS material, orientation as per vehicle | all tests | Brisk | 500,000 | 3 | LOW |
| **Infotainment & ADAS** | **Simulator for GNSS, e-Call, 5G** | Testing infotainment and in-vehicle systems with real world scenarios | Performance & Compliance testing for GNSS/ LTE/ 5G/ Sirius XM Radio/ e-Call | NI / Keysight | 26,700,000 | | **HIGH** |
| | **Channel Emulator** | PROPSIM Channel Emulation | Simulate real world scenarios for testing performance of various automotive radios such as GNSS/ LTE/ 5G/ Satellite Radio/ FM/AM | Keysight | 89,000,000 | | **HIGH** |
| | **Automotive Radar Target simulation** | 26 GHz / 77 GHz simulator for pedestrian / cyclist / vehicle targets | Simulate scenarios for FCA, RTA, BLA, ACC, LKA | NI / Keysight | 89,000,000 | | **HIGH** |
| | **Automotive Ethernet Test** | Automotive Ethernet compliance tester | Perform protocol tests for Automotive Ethernet bridges, sources and sinks | Keysight | 44,500,000 | | **HIGH** |
| | **Audio Speaker / driver quality measurement** | 24 channel Digital signal analyser 44kHz | Perform tests for audio fidelity and in-vehicle experience | NI | | | **HIGH** |
| | **Video/ Media quality measurement** | LVDS, Analog, CVBS, HDMI, AVB standard tester | Perform tests for various video transmission interfaces in vehicles | Keysight | 445,000,000 | | **HIGH** |
| **EMI/EMC with dynamo + charger** | **EMI/EMC test facility** | Perform vehicle level EMI / EMC testing with dynamometer and charger | Perform vehicle level EMI / EMC testing with dynamometer and charger | AVL / R&S | | | MEDIUM |

| COMPONENT | EQUIPMENT/ FIXTURE | SPECIFICATIONS | TESTS PERFORMED/ PURPOSE | RECOMMENDED SUPPLIER | COST ( INR, W/O GST) | DELIVERY TIME (WEEKS) | OPERATOR SKILL LEVEL |
|---|---|---|---|---|---|---|---|
| **Cell and Battery** | **Test Fixtures** | MS material, orientation as per vehicle | all tests | Brisk | 200,000 | 3 | LOW |
| **Motor & Controller** | **Dynamometer Rig - 2W** | 1. Motor Speed: 0 ~ 9000 RPM<br>2. Torque Sensor: 0 ~ 50 Nm<br>3. Bidirectional DC Power supply: 80V/300A/10Kw<br>4. Power Analyzer: 8Channel, 18bit, 1500V, 2000A<br>5. AC/DC Current Probe: 1000A, DC to 1.5MHz<br>6. DC Load bank: 900V DC / 30A / 27Kw<br>7. AC Resistive Load bank: 41V RMS max & 300A Max (Each Phase)<br>8. DAQ (Data Acquisition System) : 20Channel Module, 6.5digit DMM, 22bit | 1. Output Characteristics<br>2. DC 70 Profile test<br>3. Continuous Power test<br>4. Peak Power test<br>5. Efficiency Mapping<br>6. Speed characteristics<br>7. Net Power test at Max setting voltage<br>8. Back EMF value<br>9. Thermal Stability | 40 | 13,000,000 | 16 | **HIGH** |
| | **Dynamometer Rig - 4W** | 1. Motor Speed: 0 ~ 20000 RPM<br>2. Torque Sensor: 0 ~ 500 Nm/ 0 ~ 1000 Nm<br>3. Bidirectional DC Power supply: 1000V/300A/200Kw<br>4. Power Analyzer: 8Channel, 18bit, 1500V, 2000A<br>5. AC/DC Current Probe: 1000A, DC to 1.5MHz<br>6. DAQ (Data Acquisition System): 20Channel Module, 6.5digit DMM, 22bit<br>7. 3 phase power analyser: 4 channel voltage + 4 channel current + RPM | 1. Power characterization<br>2. DC 70 Profile test<br>3. Continuous Power test<br>4. Peak Power test<br>5. Efficiency Mapping<br>6. Speed characteristics<br>7. Net Power test at Max setting voltage<br>8. Back EMF value | | | | |
| | **Torque sensor** | 0-5Nm, 5-100Nm, Contact measurement (In-line), Ethernet | 1. Performance test<br>2. Algo test<br>3. Functionality test<br>4. Characterisation test | NCTE | 315,000 | 8 | LOW |
| | **Tachometer** | 0-9000rpm, Contact measurement (In-line), RS 232 | 1. Performance test<br>2. Functionality test | Fluke | 33,000 | 4 | LOW |
| | **DMM/ DAQ** | 19 Channels, 10V, 15A and -40degC to 800degC, Programmable | Measure Voltage, Current and Temperature throughout the test | Keithley | 525,000 | 4 | MEDIUM |

| COMPONENT | EQUIPMENT/ FIXTURE | SPECIFICATIONS | TESTS PERFORMED/ PURPOSE | RECOMMENDED SUPPLIER | COST ( INR, W/O GST) | DELIVERY TIME (WEEKS) | OPERATOR SKILL LEVEL |
|---|---|---|---|---|---|---|---|
| **Motor & Controller** | **Motor Controller HIL** | 4 channel 1000V, 300A power HIL system | 1. Perform functional verification of control stage<br>2. Simulate various scenarios for acceleration, traction loss, 4WD etc | Opal RT / DV | | | **HIGH** |
| | **Motor Simulator** | 41V RMS line-line, Power Factor of 0.8A at 400Hz, operating frequencies 0-700Hz | 1. Functionality test<br>2. Performance test<br>3. Characterization test | Retrack | 395,000 | 12 | LOW |
| | **Bidirectional power supply - 15 KW** | 80V, 200A, Programmable | 1. Functionality test<br>2. Performance Test | EA | 1,700,000 | 5 | LOW |
| | **cRIO - Chassis and modules** | Real time computing, 0-60V Multifunction module - DI, DO, AI and AO, -10 to 200degC measurement card | all tests | NI | 2,000,000 | 12 | **HIGH** |
| | **Test Fixtures** | MS material, orientation as per vehicle | all tests | Brisk | 500,000 | 3 | LOW |
| **Infotainment & ADAS** | **Simulator for GNSS, e-Call, 5G** | Testing infotainment and in-vehicle systems with real world scenarios | Performance & Compliance testing for GNSS/ LTE/ 5G/ Sirius XM Radio/ e-Call | NI / Keysight | 26,700,000 | | **HIGH** |
| | **Channel Emulator** | PROPSIM Channel Emulation | Simulate real world scenarios for testing performance of various automotive radios such as GNSS/ LTE/ 5G/ Satellite Radio/ FM/AM | Keysight | 89,000,000 | | **HIGH** |
| | **Automotive Radar Target simulation** | 26 GHz / 77 GHz simulator for pedestrian / cyclist / vehicle targets | Simulate scenarios for FCA, RTA, BLA, ACC, LKA | NI / Keysight | 89,000,000 | | **HIGH** |
| | **Automotive Ethernet Test** | Automotive Ethernet compliance tester | Perform protocol tests for Automotive Ethernet bridges, sources and sinks | Keysight | 44,500,000 | | **HIGH** |
| | **Audio Speaker / driver quality measurement** | 24 channel Digital signal analyser 44kHz | Perform tests for audio fidelity and in-vehicle experience | NI | 445,000,000 | | **HIGH** |
| | **Video/ Media quality measurement** | LVDS, Analog, CVBS, HDMI, AVB standard tester | Perform tests for various video transmission interfaces in vehicles | Keysight | | | **HIGH** |
| **EMI/EMC with dynamo + charger** | **EMI/EMC test facility** | Perform vehicle level EMI / EMC testing with dynamometer and charger | Perform vehicle level EMI / EMC testing with dynamometer and charger | AVL / R&S | | | MEDIUM |

## 3.4. Recommendations For Operational Efficiencies

The following are the operational efficiencies that were highlighted during the stakeholder consultations:

**1. Skilled Manpower and Cross-Training:**
Train lab operators in multi-equipment operation to reduce downtime due to absenteeism.

**2. Equitable Access to Facilities:**
Ensure fair and equitable access for startups and smaller users.

**3. Transparent Pricing:**
Provide clear and accessible information on testing service charges by publishing a standardized, subsidized rate card. Hosting this on a simple, interactive website listing available facilities and pricing will reduce delays and help startups plan effectively.

**4. Startup Bundles:**
Offer curated testing packages for startups—combining commonly needed services at subsidized rates—to improve affordability and encourage early-stage innovation and prototyping.

**5. Expert Support for Startups:**
Provide expert support to startups by offering expert guidance to help startups identify only the essential tests needed (& also interpretation of results by experts). This prevents unnecessary testing, saving both time and resources.

**6. Collaboration with Academia/Industry:**
Enable student researchers and interns to support testing operations under supervision.

**7. Awareness about the facility:**
Creating awareness to ensure wider outreach, engagement, and utilisation by relevant stakeholders.

CHAPTER 4

# SCALING THE INITIATIVE

### Recommended Project Proposal: Establishment of EV Test Track Infrastructure in CSN Region

Enabling the research study transitions into the implementation phase, the focus shifts beyond merely mapping machines and tools for EV powertrain component manufacturing for MSMEs. With the accelerating growth of electrification, there is a clear need for establishing regional testing and homologation infrastructure to support the rapid development, validation, and deployment of electric vehicles (EVs). Currently, under the National Automotive Testing and R&D Infrastructure Project (NATRIP), seven major facilities exist across the country catering to testing, inspection, and a range of certification needs. However, with the rise in EV-focused OEMs and increasing demand, the establishment of additional regional centers has become more pressing and relevant.

### Location Rationale – CSN Region

The decision to establish the facility in the CSN region is based on a combination of strategic foresight and practical industry alignment. It is rapidly emerging as a critical hub within the national electric vehicle (EV) ecosystem due to its proximity to several upcoming EV Original Equipment Manufacturers (OEMs), Tier 1 suppliers, and a growing base of dynamic startup clusters. Its location offers seamless industry linkages and ensures the facility can provide real-time support in prototyping, testing, and validation—thereby reducing turnaround time and accelerating time-to-market for local manufacturers.

This strategic placement also brings substantial logistical and cost advantages, particularly for local startups and auto component manufacturers (ACMs) who require timely and affordable access to testing and certification services. By minimizing transportation-related delays and expenses, the facility enhances operational efficiency for resource-constrained MSMEs. Additionally, the region is well-positioned to evolve into a regional hub for innovation and certification, offering a robust platform for accelerated product development, regulatory compliance, and commercialization support. Over time, the facility is expected to strengthen the regional EV value chain and contribute meaningfully to the broader industrial transformation underway in India's mobility sector.

## KEY COMPONENTS OF THE PROPOSED FACILITY

**1. Physical Test Tracks:**

• Acceleration, braking, gradient, and handling tracks tailored to EV performance characteristics.

• Real-world simulation zones including urban, highway, and rural road conditions.

**2. Homologation and Validation Support:**

• In-house vehicle inspection, component testing, and certification support aligned with AIS/BIS/ICAT norms.

• Advanced Data acquisition and benchmarking tools.

The establishment of the EV test track facility in the region represents more than just a infrastructure for various kind of testing and R&D—it serves as a catalyst for regional industrial transformation. Beyond supporting product validation, it is poised to generate new business opportunities, upskill the local workforce, and position the region as a leading cluster in India's green mobility transition.