Development of Standards and White Papers on eMobility

13th March 2024

Standards Developed

DST along with BIS developed **25 Nos Indian Standards** for Electric Vehicle Charging Infrastructure, covering the charging requirements of 2,3 & 4 wheeled vehicles, eBuses & eTrucks.

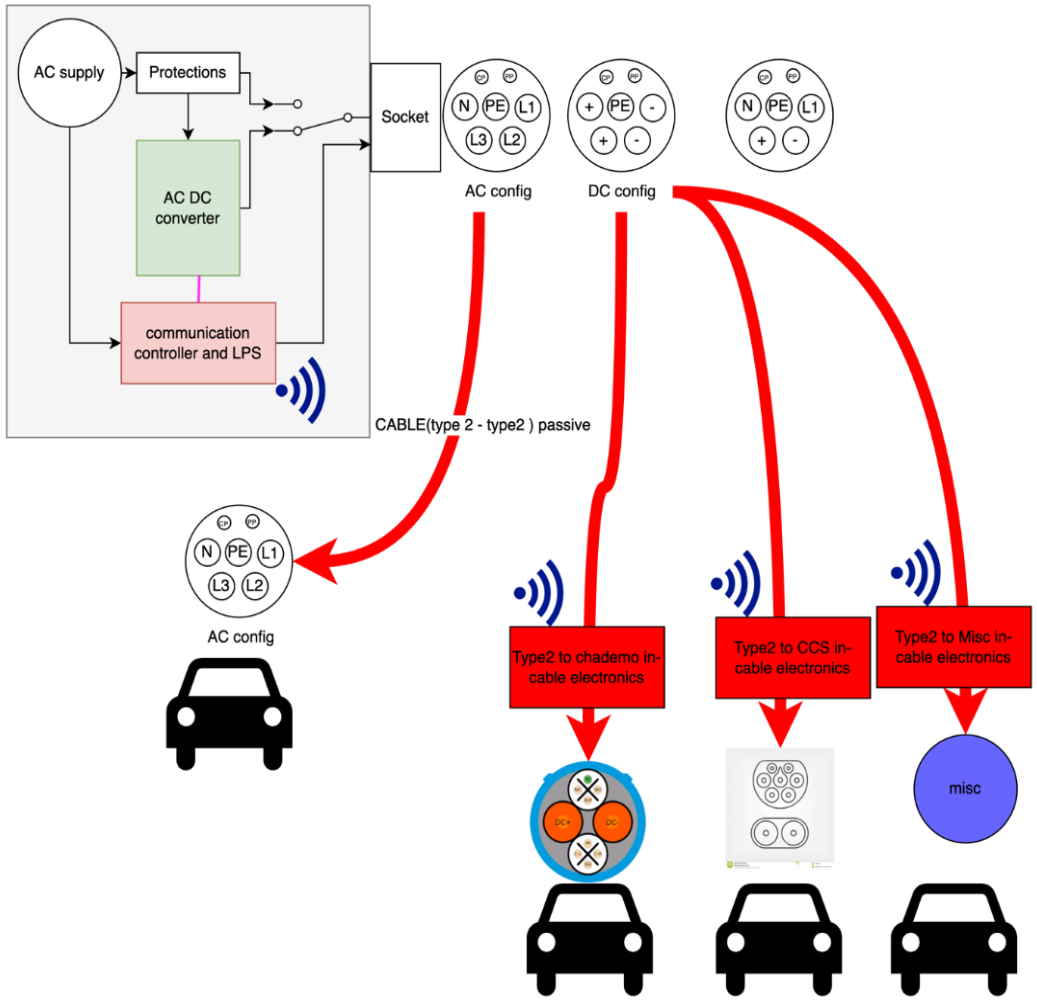
1. The Standard on '**Light Electric Vehicle AC Charge Point**' was developed indigenously with wider consultation with stakeholders. 100+ prototypes have been developed and tested for the safety and performance. 30,000 units installed. This standard widely adopted by 2&3 wheeler vehicle OEMs.

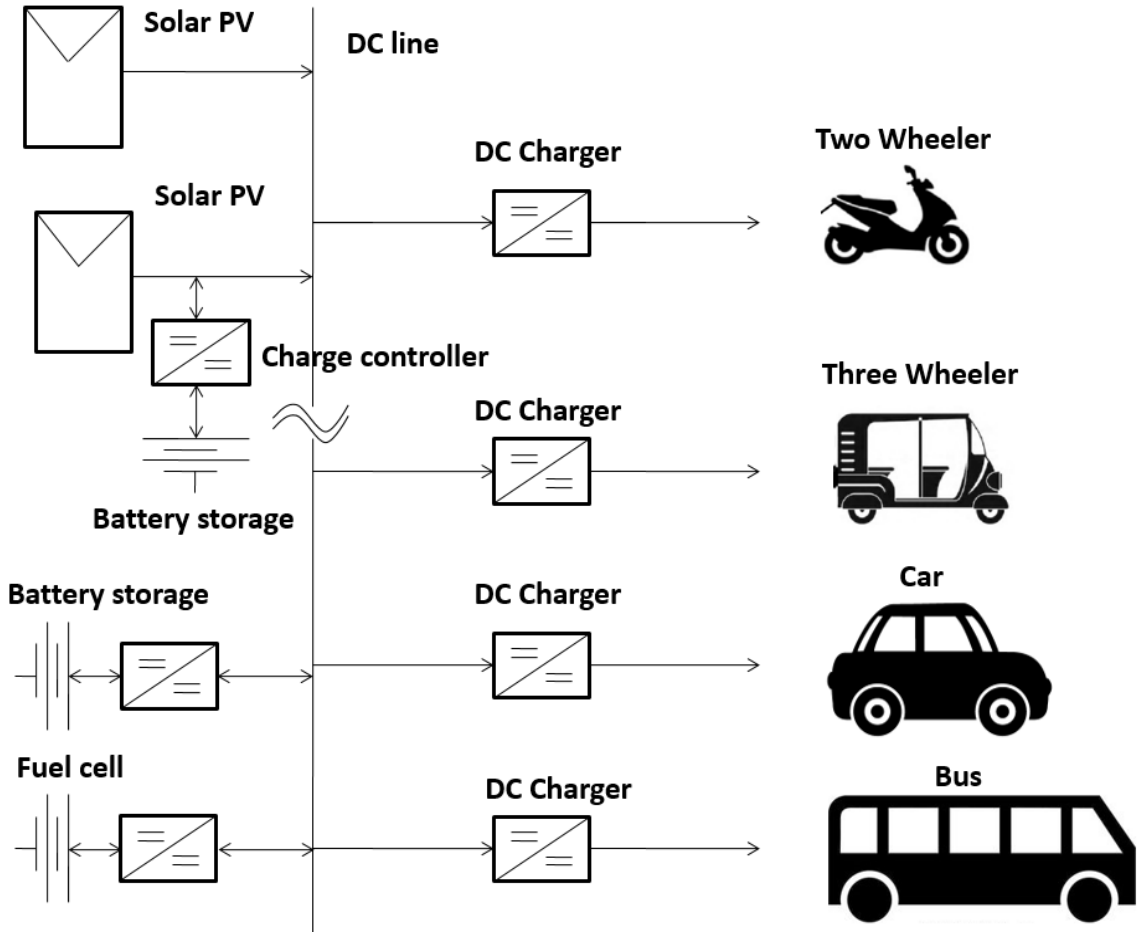
2. The Standard on ' **Dual Gun Charging for Electric Buses**' was also developed indigenously. This has been field tested at Ahmedabad where eBus fleet is running based on this technology..

3. The Standard on **'Interoperable Battery Swapping for 2 & 3 wheelers'** were developed indigenously. Common battery dimension, connector system and communication protocol and backend network have been defined.

4. The Standard on **'Pantograph charging of electric Buses**' was also developed. This has got huge potential to address fast charging needs of bus segment through a common interoperable charging infrastructure.

5. Parkbay Charging





White Papers on eMobility : Technology Challenges

Battery

- Safety (thermal)
- Energy density
- Power Density
- Cycle life, C-rate
- Materials (Li,Co)
- Mfg Equipment
- Recycling Technologies
- Standards

Traction Motors

- Rare earth materials
- Magnet Manufacturing
- Efficiency Enhancement
- Thermal Management

Power Electronics

- AC-DC Converters
- DC-DC Converters
- WBG converters for onboard charger

EV Charging Infrastructure

- **Standards** (Vehicle & Component level)
- **Electricity Mix** (Integration with renewables)
- **Testing infrastructure & certifications**

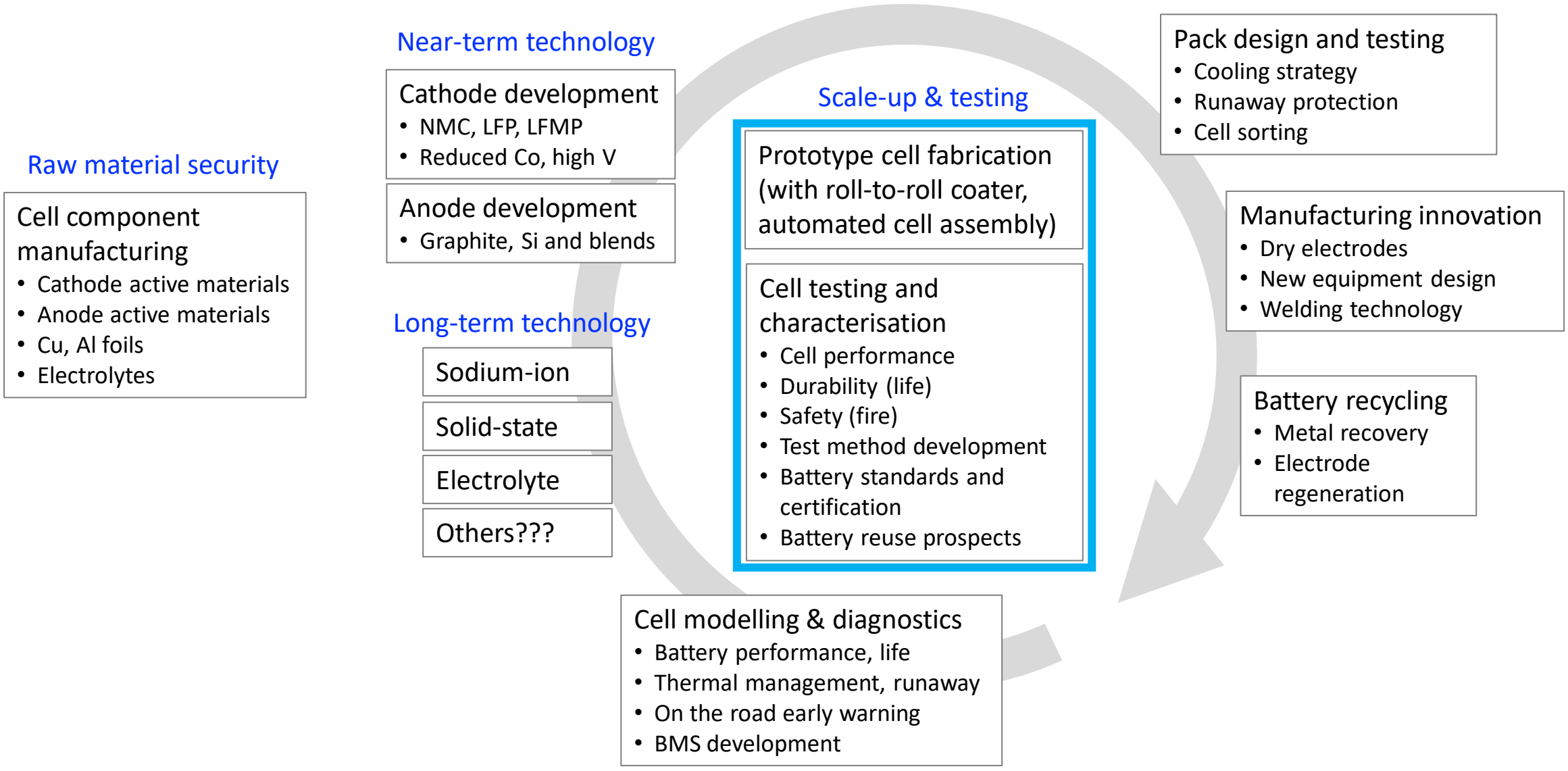
Tropical EV Battery

Problem Statement : What is unique to India ?

- Tropical conditions
- Vehicle segments and drive cycles
- Imported cells, manufacturing capability not fully established
- Lab-scale focus (TRL 1-3), limited capability for scale-up from lab to manufacturing (TRL 4-6)
- Access to key cell raw materials
- Battery safety/standards
- Battery reuse and recycling not established

Need strategic focus and roadmap enabling India EV battery technology

R&D Intervention



Challenges in Power Electronics & Machine Drives

High initial cost of vehicles	• RE Magnet-free design • Lower RE magnet temperature and volume	• Indigenization of power electronics systems, components, devices • Reduce need for sensors • Reduce number of power conversion units • Design for higher efficiency, compactness,
Limited range	• Regenerative braking, overall drivetrain efficiency • Faster charging • Compact components, high power density, functional integration • Simpler thermal management system	
Limited power/ speed/ acceleration	• Enhance power density of motor and other components that handle flow of power • Fast motion control with combination of power electronics and Digital Signal Processing to achieve better performance • Develop High Voltage System to accelerate charging time	
Safety	• Intelligent control of charger and battery pack • Better thermal management system • Condition monitoring and failure detection • Intelligent Gate Drivers to protect IGBT/ MOSFEts • Functional safety design	
Environment for development and testing	• Motor configurations and the power circuit topology to meet the functional requirements of vehicle types. • Test setup with regenerative capability to meet the functional requirements prior to endurance trials • A simulation environment with a Software in Loop (SiL) feature. Digital controller firmware with Hardware in Loop (HiL) feature is needed to fine tune the firmware.	

Proposed R&D Themes/ Programs

Simulation/ Digital Twins
Development and application of simulation tools to study different motor configurations and power circuit topology in order to meet functional requirements as well as vehicle dynamics of various vehicle types.

Permanent Magnet Motors
Development of permanent magnet synchronous motor for various categories of electric vehicles along with

- cost reduction and
- reduced usage of critical materials.

Magnet-Free Motors: To develop alternative motor technologies with comparable efficiency, power density and torque density as REPM, along with capability of higher speed operation. Various topologies of Switched Reluctance Motor and Synchronous Reluctance Motor will be the main focus.

Magnets for Permanent Magnet Motors:
Development of competency in the entire value chain of magnets for electric vehicles, including

- rare earth permanent magnets using materials available in India and
- alternative magnets with lower cost, comparable energy products and other characteristics required by electric vehicle traction application.

Inverter and DC-DC Converter:
Achieving self-reliance in PE design and manufacturing for EVs.
Create echo-system for varieties of PE converter products in India by 2030, encouraging industry across all sectors to invest and collaborate with academia to establish a PEMD supply chain.

Wide Bandgap Semiconductors: Development of competency in design, fabrication and application of Wide Band Gap semiconductor devices.

Challenges in EV Charging Infrastructure

1. What is the optimum charging infrastructure configuration for LEVs ?
2. What could be the best-fit technologies for high power EV charging of e-buses and e-trucks ?
3. How can we ensure high-level of interoperability in EV charging for users ?
4. How can we improve the business viability in the EV charging value chain?

Key Innovation ideas

- Charger Hardware Standardization
- Universal Infrastructure Charger (UIS)

Recommendations

- Product development support LEV-DC
- Development of Universal Socket for Parkbay Charging
- Testing and validation program for battery swapping interoperability
- Technology validation and field trials for Automated Pantograph charging