Government of India
Ministry of Science & Technology
(Department of Science & Technology)

DHI-DST Technology Platform for Electric Mobility (TPEM)

1st Call for Proposals, January 2017

In January 2013, the Government of India (GoI) unveiled the National Electric Mobility Mission Plan 2020 (NEMMP-2020) that set a target of 6-7 million electric vehicles sales in India by the year 2020. Subsequently, in April 2015, the FAME-India (Faster Adoption and Manufacturing of Electric Vehicles in India) scheme was launched by the Department of Heavy Industry (DHI), GoI.

On 1st February 2016, a **Technology Platform for Electric Mobility (TPEM)** was initiated jointly by the **Department of Heavy Industry (DHI)** and the **Department of Science & Technology (DST)**, to implement "*demand driven R&D to achieve desirable target specs*" to increase the domestic capacities of product and technology development aimed at making the xEV market self-sustaining. Under this arrangement, the Department of Science & Technology (DST) is inviting Project Proposals in the following five areas, to be undertaken as Consortia Projects involving multiple companies and academic institutions.

Consortium Project Proposals are invited under DHI-DST TPEM.

(Project proposals from Dec.1, 2016 to Jan.15, 2017, in DST).

The Consortia projects will be eligible for grant-in-aid funding generally upto 60% and with user-industry partners (vehicle & component manufacturers) expected to contribute the rest in terms of resources, manpower, equipment, facilities etc.

Project Topics

TPEM Program-1 Lithium Battery

Project-1.1 Two Wheeler Traction Battery [48V, between 1-2.5 kwh];
Project-1.2 Three Wheeler Traction Battery [48V, between 3-5 Kwhr];
Project-1.3 Four Wheeler Traction Battery [72V, max-16/24 kwh];
Project-1.4 Bus Traction Battery

TPEM Program-2 Charging Infrastructure

Project-2.1 AC Chargers with Net Metering facility:
Project-2.2 Assess the capability charging stations based on DC Charging technologies for low voltage vehicles (2W, 3W & small cars) through a pilot and case study
Project-2.3 Technology pilots for EV Bus Charging at Bus Depots for Urban Transit Fleets.
Project-2.4 Technology pilot for communication channel & protocol between the vehicles, charging stations and control station.

TPEM Program-3 Driving Cycle & Traffic Pattern

Project-3.1 Segmented studies on the Urban Driving Cycle & Traffic Pattern

TPEM Program-4 Motors & Drives

Project-4.1 E- Two Wheeler (e-2W) Reference Vehicle
Project-4.2 E- Three wheeler (e-3W) Reference Vehicle

TPEM Program-5 Lightweighting of xEVs

Project-5.1 Develop and test a lightweight full xEV and related technologies.

Detailed Call for Proposals, TPEM/ Jan.2017

TPEM Program-1 Lithium Battery

Lithium ion battery packs have to be developed for xEVs considering the specific nature & usage of the vehicles in the country. The program can begin with designing of LIB module using imported cells, to provide battery packs to the companies for test cycles/ validation/ onboard testing.

The R&D efforts will be to develop 3-4 modular battery systems that can be used to build the various packs that can be utilized in xEVs for mass transportation (2W, 3W, Taxis & Buses) and for hybrid-electric personal vehicles. Reference Battery Management Systems (BMS) are needed to study the strategies to control overcharge, deep discharge, cell balancing, and to estimate State-of-Charge (SOC), State-of-Health (SOH), etc.

Demonstrate with 12V module & 48V module; Battery chemistry will be LFP/ NMC/ LMO/ LTO; BMS integration and battery pack development. Design standard battery modules for 2W, 3W and Buses. [Priority will be given to possible commonisation, for example among project 1.1 & 1.2]

Project-1.1 Two Wheeler Traction Battery [48V, between 1-2.5 kwh];

Project-1.2 Three Wheeler Traction Battery [48V, between 3-5 Kwhr];

Project-1.3 Four Wheeler Traction Battery [72V, max-16/24 kwh];

Project-1.4 Bus Traction Battery

400 V nominal; 100 kwh] for midi-bus ~10-13 tonne, 9-10 meter bus.

750V nominal; 250 kwh for full size upto 18.5 tonne, 12 meter bus.

TPEM Program-2 Charging Infrastructure

Project-2.1 AC Chargers with Net Metering facility:

Development of AC charging device as per the Charging Device and Protocols recommended by ARAI, and its pilot deployment. A Net Metering communication protocol needs to be developed, compliant to the metering specifications set up by CEA and ARAI charger standards. It must demonstrate communication between the net meters, the vehicles and the control center of the utility through which the consumers would be informed about the TOD prices, the event for vehicle to grid requirement etc.

Project-2.2 Assess the capability charging stations based on DC Charging technologies for low voltage vehicles (2W, 3W & small cars) through a pilot and case study

Assess the capability charging stations based on DC charging technologies for low voltage vehicles (2W, 3W & small cars) through a pilot and case study (of CHAdeMO and other technologies) that are currently being implemented worldwide for fast charging of vehicles with higher capacity of batteries at a high voltage. If the same technology can be retrofitted or adapted to provide charging facility for the low voltage based vehicles, then a common hardware can be implemented to standardize the charging stations. Few pilots are to be implemented to assess the capability and fleet patterns on both CHAdeMo and other technologies.

Project-2.3 Technology pilots for EV Bus Charging at Bus Depots for Urban Transit Fleets.

Bus Fleets can run a predicted number of trips before charging at its depot, due to defined routes, timings and expected traffic on the routes, and is the best option to increase the electric vehicle penetration in cities. This project will be to develop & demonstrate the use of Bus Fast Charging Systems at the bus depots/ end points/ terminals. This will not involve charging at bus stops. The three mechanisms could be Top-Down Pantograph, Battery Swapping and Charging Post.

Project-2.4 Technology pilot for communication channel & protocol between the vehicles, charging stations and control station.

To enable consumer decisions on when and where to charge the vehicle, the EV must communicate with charging stations (fast and regular charging) about their state of charge, the number of slots available at a particular charging station, the current pricing of charging etc. The effect of the charging stations on the grid and grid technologies would also be a part of the pilot. The project must demonstrate the coordinated charging of EVs fleet and facilitate the study/ simulation of grid load management scenarios, bidding strategy for the charging stations etc for the aggregators to manage the costs of power. Focus should be on fast charging as the grid impact is significantly higher.

TPEM Program-3 Driving Cycle & Traffic Pattern

Project proposals are invited from companies/ institutes/national R&D laboratories/ PSUs with relevant experience in this field, preferably as collaborative/ consortium efforts with the participation of automotive companies and/or EV solution providers

Project-3.1 Segmented studies on the Urban Driving Cycle & Traffic Pattern

for different categories of vehicles have to be undertaken by both using telematics equipment and traffic surveys. The data collection exercise would be conducted over a period of 1 year, covering winter, summer & monsoon.

Vehicle Segment: 2W, 3W, 4W (M1 & N1), & Buses

Cities: Delhi, Mumbai, Bangalore

Coverage: > 50% geographic (covering all traffic density patterns, both peak & off-peak)

Sample size for each category of vehicle: To be proposed (Minimum 10)

Vehicles to be used for study: Should be < 3 years old / 40,000 kms. Wherever xEVs are available, preference should be given to it.

Information to be captured

- Traffic pattern (route, day, time & season)
- Start, stop & idling (time & numbers)
- Speed profile (Average speed, acceleration, deceleration, cruise)
- Trip information: No of trips/ day, distance covered/ trip,
- Parking information: Duration & location of parking, Type of parking
- Driver behaviour: Use of clutch, accelerator, brakes and air conditioner.
- Ambient Weather Information
- Electrical Load: End of trip SOH-Battery.
- Post information being captured, this should be integrated to provide examples of EV drive cycle for 2 wheeler, 3 wheeler, 4 wheeler and Bus.

TPEM Program-4 Motors & Drives

Proposals are invited for technology development, design and large scale prototype manufacture to demonstrate technology readiness for motors and power electronic drive meeting the following specifications. Innovative competitive technology development ready to scale up to large scale manufacture is the scope of this initiative. Proposals exceeding the minimum specification below are welcome.

Project-4.1 E- Two Wheeler (e-2W) Reference Vehicle

Kerb weight(Kg) Passenger load (kg)	100-120 150	100-120 150	100-120 150	120-140 150
Motor rating. (Watts) Cont/peak	500/1000	1000/2000	1500/3000	2000/5000
Voltage .(Volt DC)*	48 Pb A/ Li B	48 Pb A/Li B	48 Pb A/Li B	48
Maximum Vehicle speed (km/h)	45	60	60	80
Mounting	Wheel (hub)/Frame			
Maximum motor speed (rpm)	555/5000	750/6500	750/6500	8000
Continuous Torque(Nm)	13/1.3	18/1.8	21/2.1	5**
Minimum Peak Torque (Nm)	To propel the vehicle on a 7^0 gradient at >10 km/h			
Power Electronic controller	Separate OR Integral	Separate OR Integral	Separate OR Integral	Integral OR Separate
Regenerative braking	Yes			
Ambient temperature	-10°to 60°C			
Protection	IP65			

* The design of both motor and controller should be capable of scaling up to 72 Volt dc.

**Single stage gear box (about 7:1 ratio or as such required to meet the overall target situlated) will be used along with the motor. The motor may be integrated with the transmission or is capable of being mounted on the gearbox.

Project-4.2 E- Three wheeler (e-3W) Reference Vehicle

Kerb weight (kg) Passenger load (kg)	250kg to 350 kg 375
Motor rating (Watts) cont/peak	2000/3500
Voltage (Volts dc)	48
Maximum vehicle speed (km/h)	30
Mounting	Frame mounting
Gear box	Yes (about 12:1 or as required for the vehicle)
Maximum Motor speed (rpm)	6500
Maximum peak torque	To propel the vehicle on a 7^0 gradient at >5 km/h
Power electronic controller	Integrated or Separate
Regenerative barking	Yes
Ambient temperature and protection	-10^0-60 ^{0}C IP65

Project Scope

- The Project Proposal should undertake development of both motor and power electronic drive, and should indicate the type of motor (SRM, Induction Motor and Synchronous Reluctance motor [SynRM]), the innovation and its suitability for electric vehicle. Motor design without rare-earth magnet will be preferred. The frame mounted motor may use transmission with gear box, but it is need not be part of the proposal. However the basic design should be capable of integrating with gearbox.
- The efficiency of the motor is an important criteria and the proposal must explain the strategy to achieve the highest kW/kg for the motor . The minimum efficiency (motor & drive combined) supported by simulation result should be submitted along with the proposal. Target motor peak

efficiency >92%. Target peak power density should be greater than 0.6Kw/kg for frame motor and 0.3kw/kg for hub motor.

- Compact, lightweight power electronic controller for speed and torque control in response to input from vehicle sensors and controller is to be developed with ability to withstand vehicle vibration, ambient temperate, vehicle voltage transients and meeting IP65 spec for enclosure. The efficiency of the power electronic drive controller should be more than 95% and target combined motor and controller peak efficiency should be greater than 90%
- The electronic drive unit should be designed to respond suitably to starting switch signal, throttle sensor, brake signal, charging input signal etc. It should incorporate protection features like short circuit protection, over current limit, over-voltage protection, under-voltage protection, thermal shutdown, protection against EMI, drive disable features etc. Can Bus integration will be seen as a positive addition.

Evaluation Criteria: Cost of the complete system consisting of motor and control; Weight and size; Power and torque density; System efficiency; Noise and vibration; Life and Reliability; Scalability of basic design and Vehicle integration features.

TPEM Program-5 Lightweighting of xEVs

Project-5.1 Consortia project proposals are invited to develop and test lightweight solutions

The vehicle body structure, chassis and all sub-systems such as powertrain, suspension, steering and braking systems, energy storage systems, and other miscellaneous mechanical and electrical hardware, which can be integrated into an optimally designed xEV that will meet customer requirements in terms of aesthetics, functional performance (in attributes such as ergonomics, aerodynamics, vehicle dynamics, NVH, durability, crashworthiness, etc.) and cost, as well as comply with applicable government regulatory requirements.

Crashworthiness should be incorporated and established at component, sub-system and vehicle levels for conformance to EuroNCAP and IIHS safety standards. Exploration of multi-material body design (using HSS, aluminium, magnesium, composites, cellular and sandwiched materials, etc.) with advanced joining and forming processes should be emphasized.

The proposal should offer a measurable way of assessing the effectiveness of proposed lightweighting strategies/ innovations through their integration into an existing 5 or 6 seater vehicle, leading to a 30-50% lighter vehicle prototype.

The project team is expected to comprise of:

- Institutes/ national R&D laboratories with documented expertise in Vehicle Design driven by CAE (Computer-Aided Engineering) and selective testing.
- An automotive OEM (Original Equipment Manufacturer) which has designed and developed production vehicles in India should be part of the proposal and be responsible for delivering a functional prototype in the form of a lightweight plug-in electric or hybrid-electric Vehicle with an option for operation in fully electric mode.
- Tier-1 automotive suppliers should be partners in a proposed project.

Submission of proposals

The proposals in DST/TPEM specified format (www.dst.gov.in) may be submitted (1 hard copy + soft copy of proposal in PDF) between Dec.1, 2016 and Jan.15, 2017 to:

Mr. Sajid Mubashir, Scientist G (Email: sajid@nic.in) , TDT Division, Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi- 110016.

You may write to us at sajid@nic.in for any clarification, or for receiving the application form in .docx (Word) format etc. Phone number: 011.26512463