

## Sample Problem Statements

### **Theme: Energy: Clean**

**Problem Statement:** Development of a data collection/analysis system for prediction of availability of agricultural residue/biomass and its efficient collection across India

**Expected Output:** Currently no accurate/updated data available regarding agro-residue availability. Limited number of players in the field of biomass collection. System can help in creating a biomass supply chain.

### **Theme: Energy: Clean**

**Problem Statement:** To develop efficient gas purification systems, this is targeted in usage of biomass reactors which produce hydrogen

**Expected Output:** Need to propose a method of gas production and collection by using techniques related to Bio Fuels from Bio mass. Target is cost reduction by improving the yield. The commonly used system for gas purification is Pressure Swing Adsorption (PSA). Significant amount of product gas is lost along with the impurities in the waste stream. Multistage PSA is required for capturing the product gas from waste stream, which adds up to the cost. Other techniques known are Vacuum Swing Adsorption, Amine scrubbing, molecular sieve filtration – which also have some challenges that one can consider as problem statement

### **Theme: Energy: Energy Storage**

**Problem Statement:** To develop novel, low cost, earth abundant electrode materials for battery

**Expected Output:** Currently Li-ion based battery chemistries are most common in all batteries being used in electric vehicles. Li is a rare material, hence there is a need to explore/develop alternative materials. Expected prototype should have a demonstration of a cell with the electrode material, with comparison against current available materials. Further a full prototype of a battery can be shown.

# Sample Problem Statements

## **Theme: Energy: Energy Storage**

**Problem Statement:** To develop novel electrode architectures

**Expected Output:** Currently all Li-ion batteries are manufactured / assembled / packaged in a certain way. Which many times limit their performance? For example electrode architecture influences the temp/current distribution within the cell. New methods of electrode architecture, to be demonstrated by making a prototype and showing the comparison with current available techniques.

## **Theme: Energy: Energy Storage**

**Problem Statement:** Demonstration of Battery application for Grid stabilization

**Expected Output:** Prototypes for catering to applications: energy management, backup power, load leveling, frequency regulation, voltage support, and grid stabilization. Currently only Lead-Acid batteries are being used for grid storage and they can't do grid stabilization effectively

## **Theme: Energy: Energy Generation**

**Problem Statement:** Development of Nafion membrane for fuel cells

**Expected Output:** Currently Dupont's Nafion is the only membrane brand available in the market. An alternate patentable material. Development of advanced polymeric materials, which will satisfy the technical and economic demands of the consumers. Most alternative membranes are outperformed by Nafion membranes over an entire set of important properties, it may be worthwhile to compromise on certain parameters to develop alternative specialized membranes.

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### **Theme: Energy: Energy Generation**

**Problem Statement:** Thermal management in fuel cell

**Expected Output:** There is a lot of waste heat generated in a fuel cell which can be effectively utilized, we invite processes to utilize heat generated to convert to energy which can be stored.

### **Theme: Energy: Energy Generation**

**Problem Statement:** Design and Develop an Energy source to power one small rural home. Device should be able to power common appliances viz. light, fan, mobile charger etc.

**Expected Output:** Large part of rural India is unelectrified. Availability of electricity is directly linked to quality of life, solid oxide fuel cell research is in its nascent stage and we invite ideas in this area.

### **Theme: Energy: Energy Generation**

**Problem Statement:** Portable Energy source for use in disaster relief

**Expected Output:** India needs such a product which can generate electricity for quite a duration of time, uninterrupted. We invite ideas to build such a product, there should be innovation seen in the idea.

### **Theme: Energy: Energy Generation**

**Problem Statement:** Efficient way to handle, dispose and/or convert a particular category of waste to energy

**Expected Output:** We invite innovations which convert waste to energy

# Sample Problem Statements

## **Theme: Mobility: Clean**

**Problem Statement:** New composition of fuels

**Expected Output:** Looking out for research in basic chemistry change for creation of new fuels which will be less polluting. We expect a demonstration of the use of this fuel in a vehicle. There should be certifications from well-established labs showing comparisons and advantages of using this new fuel. Prototype to be an engine running on the new fuel if core innovation is fuel, with test reports of emission. Prototype to be a vehicle run on the new fuel extracted, if its process related to extracting the fuel. Results of emission test is necessary from approved lab.

## **Theme: Mobility: Clean**

**Problem Statement:** New processes in manufacturing of fuels

**Expected Output:** We expect the new process to be shown in a format for video and the fuel so got to be tested on a vehicle and emissions measured to show as proof of the advantage of the new process.

## **Theme: Mobility: Clean**

**Problem Statement:** Compressed air as a working fluid

**Expected Output:** Here the expected output is to show the compressed air being used as a working fluid on a real vehicle. There should be certain systems which will account for the recharging of the air as range is the major hurdle to be solved in this system.

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### **Theme: Mobility: Clean**

**Problem Statement:** To develop cost effective, high yielding biological hydrogen production with the use of bacteria.

**Expected Output:** Based on the mode of H<sub>2</sub> generation, the biological routes for H<sub>2</sub> production are categorized into four groups: photo biological fermentation, anaerobic fermentation, enzymatic and microbial electrolysis, and a combination of these processes. Challenge will be to surpass the benchmarks available on the internet and provide commercially viable solution

### **Theme: Mobility: Clean**

**Problem Statement:** An integration of this engine with the vehicle and showcasing the range of the vehicle at least one km before a refill requirement. Also have ideas on the infrastructure which will be required to fulfill a compressed air vehicle mode of transport.

**Expected Output:** The expectation is a prototype of the engine integrated to a normal vehicle. Should be able to integrate the air storage device and the onboard compressor in the vehicle. It should provide a mechanism to recharge the air, should last for at least a km before the recharge is required.

### **Theme: Mobility: Alternative Powertrain**

**Problem Statement:** Drivetrain specific for electric vehicle

**Expected Output:** Although there are electric motors and hub motors being used for EV, we encourage building of innovative drivetrain for EV's. The expectation is to build the drivetrain and showcase its working on a real-time vehicle. Need to have comparison parameters of efficiency etc. There has to be an innovation aspect in the drivetrain you propose.

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## **Theme: Mobility: Alternative Powertrain**

**Problem Statement:** Off road vehicles for rural areas

**Expected Output:** Vehicles which can be used in areas where road conditions are bad, worse when there are no roads. Innovation in designing a EV which can go in these areas, could be a concept without wheels!!

## **Theme: Mobility: Alternative Powertrain**

**Problem Statement:** Next gen power electronics using GAN, SiC

**Expected Output:** Power electronics play a vital part in the development of the electric vehicles, we invite projects related to component designs. To produce high-performance power devices, research for innovative performance improvements. This will include pioneering Ga<sub>2</sub>O<sub>3</sub> (gallium oxide), diamond, and other new materials, as well as developing new structures and circuits supporting foundational technologies beyond traditional power electronics.

## **Theme: Mobility: Alternative Powertrain**

**Problem Statement:** Motor design for electric vehicles, SRM, Permanent Magnet Without rare earth materials.

**Expected Output:** Motor Design for electric vehicles is an area of interest where we invite projects which deal with innovation in motor design for Electric vehicle applications. Expectations are to make the product and show efficiency and other parameter comparison with existing motors.

## Sample Problem Statements

### **Theme: Mobility: Alternative Powertrain**

**Problem Statement:** Direct DC Motors for Higher capacity and economic design

**Expected Output:** Dc motors make control strategy for electric vehicle relatively cost effective. This is a reason for inviting projects which focus on direct DC motors design being used for EV application.

### **Theme: Mobility: Alternative Powertrain**

**Problem Statement:** Thermal Challenges in Electric Vehicles

**Expected Output:** New air conditioning systems and techniques. We invite projects involving new materials and processes to remove heat. Minimizing heat loss in components. Waste heat recovery form battery, EV components. Reducing cost by inventing new materials.

### **Theme: Mobility: Alternative Powertrain**

**Problem Statement:** Hybrid (fossil fuel - electric) systems

**Expected Output:** We invite innovations in hybrid electric vehicles, use of new techniques to improve efficiency, improve battery performance and improve safety by new materials. Integration Project: Energy harvesting methods in EV, methods of providing drive using motor which is not yet available in market, Mileage, storage, recharge methods etc. Core research: Solid state components for the EV manufacturing. Integration of such components to be done on a vehicle which will demonstrate the working

# Sample Problem Statements

## **Theme: Mobility: Alternative Powertrain**

**Problem Statement:** Engine, transmission

**Expected Output:** We are inviting innovation in this area of Magnetic/Electromagnetic powertrain, innovation by having replacements for rare earth materials. An engine which can produce 1KW of power coupled to a generator. Should be able to work by taking assistance of the magnetic energy

## **Theme: Mobility: Road Safety**

**Problem Statement:** Road safety Improvement ideas

**Expected Output:** We invite ideas on road safety like the semi-autonomous drive which can reduce number of accidents. Here the expectation is to come up with solutions which are cost effective, have usage or new types of sensors, new methods of sensing etc. If it is a core research in sensor fusion the expectation is of the prototype to showcase the new sensor. If it's an integration project the expectation is the package should be near to the product deployed on a vehicle. Cheaper manufacturing of sensors, components which measure position and create maps for the autonomous vehicle Hardware and software combination which is easy to run (has low latency) in systems which are cost effective

## **Theme: Mobility: Road Safety**

**Problem Statement:** Vehicle safety systems

**Expected Output:** We invite ideas which reduce accidents by reducing tyre bursts, Infrastructure that can warn users of traffic situations, futuristic technologies like self-balancing two wheelers, Smart Helmets, Construction materials for roads which can absorb oil spills, innovative materials which can be recyclable.

# Sample Problem Statements

## **Theme: Mobility: Shared**

**Problem Statement:** Innovative designs for Interiors and exteriors, Office on wheels concepts, collapsible Structures for reducing parking space, Personal transport solutions which can be customized, easy to use.

**Expected Output:** We invite new design concepts for personal mobility, expected outcome is the final product which can be put to the market. Since this is a design related project should also have a plan to make prototype and showcase novelty in the event.

## **Theme: Mobility: Secure**

**Problem Statement:** Introduction of authenticity needs Cryptographic algorithms. ECU's are low powered systems and have to respond in real-time. So, they cannot take the performance penalty of execution of crypto algorithms. Integrity and Authentication to be completed within the given time of few milliseconds.

**Expected Output:** We invite ideas on Embedded Security in Cars Securing Current and Future Automotive

## **Theme: Mobility: Secure**

**Problem Statement:** Scenario of authentication failure during software download: If the signature of the software downloaded is wrong, then authentication fails. In case of authentication failure, the ECU should not load application. If this ECU is a critical ECU such as Airbag, authentication failure becomes a safety risk. If the failed application is booted, that's also a safety risk. We expect a graceful exit without impacting safety or the vehicle in this scenario.

**Expected Output:** We invite ideas related to automotive security related to over the air updates for vehicle ECU software

## Sample Problem Statements

### **Theme: Mobility: Secure**

**Problem Statement:** Privacy issues in Connected Vehicle communication: Connected cars provide many advantages. They need to collect lot of information about driver, his/her driving style, etc. to provide this functionality. But, Connected Cars use V2X technology which is based on broadcast messages. Broadcast messages can be listened by anyone nearby and hence driver's private data is at risk. Privacy should be safeguarded without compromising security and also providing all other features.

**Expected Output:** We invite ideas which can safeguard Privacy without compromising security and also providing all other features.

### **Theme: Mobility: Safe**

**Problem Statement:** To develop novel, low cost material/metal alloy that can sustain at temperature more than 1200°C. Reduce cost of reactors using low cost metal/ alloy. There are very few materials satisfying this requirement. Existing solutions have higher costs. There are limited number of vendors in India.

**Expected Output:** We invite ideas which can reduce cost of the existing materials used in automotive by suggesting inventive material compositions.