AN INITIATIVE BY

SAEINDIA
NORTHERN SECTION

EFFI-CYCLE CONCEPT DESIGN CHALLENGE

>>>A Step Toward Greener Tomorrow<<<

RULE BOOK

Published in India

Please Recycle

This page is intentionally left blank.

Contents

This page is intentionally left blank.

-

SECTION A- GENERAL GUIDELINES

1 Overview

1.1 Introduction

Efficycle Concept Design Challenge is an intercollegiate Concept design competition which is intended to engage engineering students (graduate as well as post-graduate) in developing the eco-friendly future mobility solutions for India. The students participate in competition in form of a team registered by the institute or university. Teams are expected to apply engineering concepts in developing the vehicles suitable for the needs of a real world user.

1.2 Purpose

The event gives participant a challenge of developing the concept of non-polluting, energy efficient vehicles of different configurations which can be used in real world in various day to day applications. The vehicle designed for this purpose must be aerodynamic, highly engineered, safe and ergonomic.

Teams can consider themselves working for a fictitious firm manufacturing the vehicles (efficycle) at mass production level. Hence the concept should be commercially viable as a market product and should be attractive to the consumers because of its visual appearance, performance, reliability and ease of operation.

1.3 Competition Summary

The Competition includes designing a virtual prototype (CAD based) of the vehicle according to this rulebook. The vehicle would be evaluated for its design, innovations, practical usage and commercial viability.

1.4 Vehicle Design and Analysis

The research, analysis and design of the vehicle must be performed solely by a team constituting current SAE INDIA student members of that college/university.

2 SAE NIS Effi-Cycle Rules and Organizing Authority

2.1 Authority of the Rules

The SAE NIS Efficycle Rules are the responsibility of the Efficycle Technical Committee and are issued under the authority of SAE NIS. Official announcements from the Efficycle

Technical Committee shall be considered part of rules and shall have the same validity as rulebook even if these were not initially included in the rulebook but communicated separately. Ambiguities or questions concerning the meaning or intent of these rules will be resolved by the Efficycle Technical Committee only.

2.2 Understanding the Rules

Teams are themselves responsible for reading, interpretation and understanding the rules of the competition. To seek the clarifications regarding the rules, teams should contact Efficycle Technical Committee at efficycle.concept@gmail.com. Teams must keep the records of all such email communications ready for reference of judges/inspectors during the event.

2.3 Participating in the Competition

Teams, their members as individuals, faculty advisors and other representatives of a registered college who are present on-site at a competition are considered to be "Participating in the Competition" from the time they arrive at the event site until they depart from the site at the conclusion of the competition or earlier by withdrawing. Hence all such individuals will be bound by the event rules effective for the current season.

2.4 Official Communication

All teams must pay attention to the official announcement made by Efficycle Organizers. All official announcements will be posted on website http://effi.saenis.org and/or at official Facebook Group www.facebook.com/groups/EfficycleSAENIS. Event organizers or Efficycle Technical Committee may directly communicate to teams/captains/facilitator/faculty advisors to provide any additional information.

Following are the official email IDs for the communication with competition organizers:

1. efficycle.concept@gmail.com : for queries, rules clarifications, event procedures etc.
2. efficycle.technical@saenis.org: for escalation of queries.

2.5 General Authority

SAENIS and the competition organizers reserve the right to revise the schedule of the competition and/or interpret or modify the competition rules at any time and in any manner that is in their sole judgment, required for the efficient and smooth operation of the event.

3 Eligibility

3.1 Eligibility Limits for Teams

All engineering students pursuing undergraduate or post-graduate courses from any recognized institute or university throughout India are eligible to form a team. More than 1 team from same institute can participate.

3.1.1 Student Status

Team members must be enrolled as degree seeking undergraduate, graduate or post graduate students in same campus of a college, institute or university.

3.1.2 Team Size

Team can have minimum 3 to maximum 5 team members from same institute. One faculty advisor may be appointed by Institute as guide to the team during complete project work. Participants may belong to any engineering discipline. In the entire team, maximum 2 members may be:

a. Post Graduate Students
b. Students who have completed their graduation in 2019.

3.1.3 SAE Membership

Team members, faculty advisor and other representative must be member of SAE INDIA at the time of competition.

3.2 Faculty Advisor (optional)

3.2.1 Status

A Faculty Advisor may be appointed by the college/university for guidance of team.

3.2.2 Responsibilities

Faculty Advisors may advise their teams on general engineering and engineering project management theory and act as guide of team. The Faculty advisors are allowed to attend the evaluation rounds along with their team at event site but will not be allowed to provide answers or justifications for any question on behalf of team.

3.2.3 Limitations

Faculty Advisors should not design any part of the vehicle nor directly participate in the development of any documentation or presentation.

SECTION B - VEHICLE REQUIREMENTS

4 Vehicle Configuration

4.1 Layout

The vehicle must have at least three wheels. All wheels cannot be in a straight line (i.e. tandem configuration is prohibited).

4.2 Rider and Payload

The vehicle may be designed for one or more riders of 75kg each. For all riders, 10kg of payload should also be considered.

4.3 Vehicle Dimension

Vehicle can have a maximum width of 60 inches (1524mm) and length of 100 inches (2540mm) covering all its rigid or movable projected parts.

4.4 Vehicle Weight

Maximum recommended kerb weight of vehicle is 150kg.

4.5 Vehicle Frame

Vehicle should be built with a protective structure. This structure will also be useful in providing the mounting of different components and sub-systems.

4.5.1 Impact Protection

The frame must protect the drivers in case of collisions & breakdowns and must prevent the entry of debris/foreign particles during running conditions. **Adequate protection for the impact from front, sides, rear and rollover should be provided.** Truss, triangulation and gusseting etc should be provided in frame suitably for proper impact load distribution and also to maintain the rigidity of structure.

4.5.2 Weather Protection

Weather protection, as per Indian Climate conditions, should also be taken into consideration for riders' comfort.

4.6 Frame Material

All materials used in vehicle frame should have the bending strength and stiffness equivalent or better than the bending strength and stiffness of a metal tube having 1 inch outer diameter, 2mm wall thickness and 365MPa yield strength.

4.6.1 Permitted Materials

Use of multiple shapes, cross-sections sizes and material grades of following is allowed:

1. Steel or Steel Alloys
2. Metals other than steel (aluminium etc).
3. Composite materials
4. Combination of one more type of material from above list

Teams should work out upon the material availability, weld-ability, joining process, light-weight properties and structural strength etc while selecting a material for frame.

4.6.2 Material Strength and Stiffness

The bending strength and stiffness of all materials used in frame should be calculated and included in report/presentation for easy reference of judges. For calculations, refer note below:

Note:

The bending stiffness and bending strength must be calculated about a neutral axis that gives the minimum values.

- Bending stiffness is considered to be proportional to the product *EI* where:
  E= Modulus of elasticity (205 GPa for steels)
  I= Second moment of area for the structural cross section
- Bending strength is given by:

$$M = (Sy * I)/C$$

  Where:
  Sy= Yield strength (365 MPa for 1018 steel)
  C = Distance from neutral axis to extreme fibre

4.7 Front Fairing

A fairing, made up of transparent sheet, is compulsory in front of drivers. In case of multi-seater vehicles, the fairing is required only in front of first row riders.

4.8 Powertrain

4.8.1 Type of Powertrain

The concept efficycle vehicle may be designed to run on any one of the following type of powertrains:

1. Fully Electric Powertrain
2. Electric and Human powered vehicle; optional to run on any power source simultaneously or alternatively. Human powertrain may also be given to one or more riders.

4.8.2 Power Source

Maximum 1 kW electric motor may be considered for powertrain design. A suitable battery-pack should be designed and specifications (voltage and capacity) should be included in the report/presentation.

Additionally, solar power system, energy regeneration system (ERS) or any other non-conventional/renewable energy sources may be included.

4.8.3 Transmission System

Transmission system is mandatory to transfer the power from motor/human power drive to wheels. Use of shafts, chain-sprockets, belt-pulleys, gears and epi-cyclic gear trains & friction wheels etc. is permitted for delivering power. The power from human and electric power-trains can be delivered to different wheels or cumulatively to same wheel/axle. Direct mounting of the motor to the wheel hub and its direct coupling to axle is not permitted.

4.8.4 Energy Efficiency

Powertrain design should be highly energy efficient to travel the maximum distance in one complete charge. The calculation of energy efficiency parameters should be presented for evaluation.

4.9 Steering

Teams may use any type of steering mechanism and steering geometry for the concept vehicle. Steering system parameters' specification and calculations should be presented for evaluation.

4.10 Suspension

Suspension is optional in concept vehicle. However any type of suspension system can be used. Suspension design parameters, their specification and calculations should be presented for evaluation.

4.11 Brakes

Any type of brake system and configuration can be used. Brake system design parameters, their specification and calculations should be presented for evaluation.

4.12 Aesthetic Requirements

Vehicle is expected to have attractive exterior and interior appearances. The different views of vehicle should be presented in form of 2D sketches.

4.13 Advance Features

Advance features or technologies can be incorporated in vehicle such that these are useful in one or more of the following:

a) Increasing occupant safety
b) Increasing vehicle's dynamic performance and efficiency
c) Enhancing Rider comfort
d) Advance Driver Assistance System (ADAS)

SECTION C - DOCUMENTATION

5.1 Concept Design Report

A design report should be prepared by the team with the details including but not limited to following:

a) Layout and Configuration of Vehicle
b) Specifications of vehicle design parameters
c) Design calculation and analysis of different subsystems
d) CAE analysis of vehicle frame
e) Key performance targets

Format of Concept Design Report (CDR) will be provided by Efficycle Technical Committee. CDR will be submitted to judges for evaluation.

5.2 Project Presentation

A Microsoft Powerpoint ® presentation should be prepared for presentation before evaluation panel during the competition. Format of Concept Design Report (CDR) will be provided by Efficycle Technical Committee.

5.3 Model/ Prototype

A small scale model/ prototype may be brought to the event site for better visualization by evaluation panel. It may be a working or non-working model of the concept vehicle. For this purpose clay models etc are also acceptable.

5.4 Customer Survey Form and Analysis

A customer survey should be conducted by teams for understanding the requirement of a real user. Teams need to design a customer survey form and take the real feedback of at least 20 end users. The feeback received from such users will be compiled, analysed and presented to judging panel. The outcomes of survey should be used in the concept design.

Note: For this purpose, the feedback of people of different age group, gender, profession etc may be taken. For example, this survey can be conducted with such uses in the college/institutes premises or at a public place etc. Evidences of conducting survey can be recorded in form of photographs, video or audio recording etc.

SECTION D – EVALUATION PROCEDURE

All teams will be evaluated in 2 separate evaluations. All teams need to participate in both evaluations.

6.1 Concept Design Presentation Round

This round will be of 45 to 60 mins (including presentation and Q&A etc.). This round aims to evaluate the team's performance on their concept for the future mobility on the basis of various parameters undertaken to design the vehicle such as design attributes, technical reasoning to the vehicle layout, vehicle subsystem design. This round will also look in to the CAE simulation and analysis performed by teams. Following are parameters which will be evaluated in this round.

a) Concept
b) Design Methodology
c) Design Considerations & Assumptions
d) Design of Subsystem (Frame, steering, suspension, brakes, powertrain, advance features etc.)
e) Calculations
f) Vehicle Layout
g) Simulation & CAE
h) Vehicle Integration & 3D models, assembly

6.2 Business Plan Round

This round will be of 45 to 60 mins (including presentation and Q&A etc.). Teams need to present a business plan to judges (hypothetical investors) demonstrating the feasibility of the concept, cost viability, user friendly features, customers' demand and overall unique selling proposition (USP) etc. Team will present the justifications about sustainability of the product (concept vehicle) in the market and hot it will provide a breakthrough for the greener mobility in terms of technology and cost. Teams would be evaluated on following points in this round.

a) Concept Comparison with market available solution
b) Unique Selling Proposition (USP)
c) Key Features of proposed design
d) Customer survey and Analysis (refer rule 5.4)
e) Cost for end user and comparison with similar product

The presentation formats will be released by Efficycle Technical Committee.