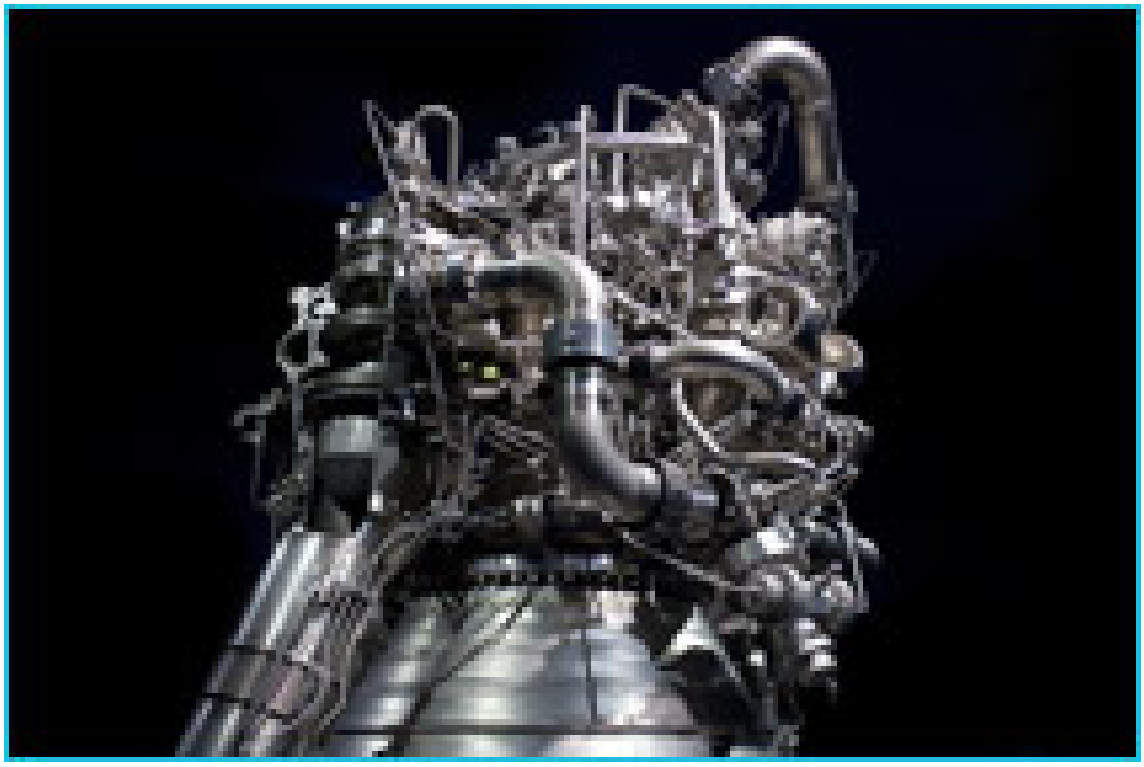

The first step of the study consists in choosing the vehicle you will work on: either 1- suborbital vehicle for high-speed long-range transportation
or
2- vehicle servicing Low Earth Orbit
.

You will pay particular attention:

- to solutions that minimise environmental impact during operational phases (manufacturing, flight, return to Earth),
- to the impacts (including maintenance) caused by the need for the rocket propulsion system to be ‘reusable’. It is welcome to refer to, and pursue, work done by previous teams.

You will then address one of the following topics:

1.

Propulsion system:

- Use of an existing engine and propulsion system: analysis of compatibility with safety requirements, environmental impacts during the whole commercial life time (carbon footprint calculation), compatibility or adaptation required to successfully reuse the vehicle at low cost and global economic performance of the vehicle. Maintenance aspects shall be analysed.
For type 1 vehicle
, alternatives to the use of rocket engines only will be analysed,

- **Or** Adaptation of a rocket engine which is the « image » of an existing one (by changing the propellant, or change of operating condition / of the thrust, …) and existing propulsion system, to be adapted to the needs of a sub-orbital vehicle transporting passengers. This adaptation must bestructured between the starting point (performance, implementation of the image engine), the target point (engine adapted to the mission of the selected vehicle) and the adaptations to be made. Safety constraints, operating costs, environmental impact, and maintenance related to reusability will be identified and addressed,
- **Or** Study and pre-dimension, and issue the identified high level requirement, for a propulsion system specifically defined by the student team,

**Or**

-

Analysis of take-off phase of a suborbital vehicle using an innovative technological system (for example: magnetic rail Maglev type, other solution, ...) for assistance to the foreseen on-board propulsion, and of the benefit / constraints that it brings to vehicle design and performance,

**Or**

- For type 2 vehicle, analysis of a concept, including the pre-dimensioning,(for its main elements) of an Attitude Control System for in-orbit evolution (dubbed « SCAB »), to be used for flight phases where the aerodynamic surfaces are inefficient (no atmosphere, or flight domains with too low aerodynamic pressure): explain technological choice, list the elements of the SCAB, installation and lay-out in the sub-orbital vehicle, assessment of the total mass (at take-off).

Input data: the analysis shall be done by taking into account a needed control torque of 1200Nm around each of the 3 control axis of the vehicle, and a total duration (cumulated) of operating , for each control axis, of 100s.

Definition: the wording “Propulsion system” means the whole system delivering a propulsive force, and it encompasses: Rocket Engine(s), propellant and fluid Tanks, the propellant Feeding Circuit, the Pressurization System, the Loading/Unloading circuits, the propulsion system Controller, all other elements necessary for the proper operating of rocket propulsion.

General characteristics of reference vehicles:

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