

FMP Presentation

Sustainable Hydrogen Endurance Racer

Daniel Loader



Project definition

What is it?

- A sustainable hydrogen powered endurance race car.
- This car will be made using as many sustainable or recycled materials as possible
- The series will have a similar concept to Formula E in how the cars are designed and used, where they will all carry the same body style. Teams be able to change and modify the hydrogen electric powertrain
- This design will keep the series competitive and exciting for the spectators

Why is it needed?

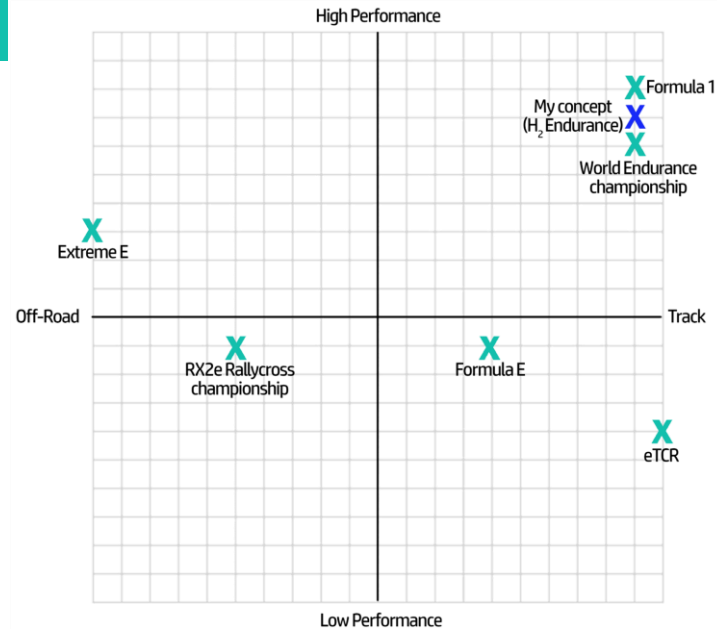
- The vast majority of global and more local level motorsports use traditional combustion engines in the vehicles being raced
- Climate change as a result of using fossil fuels is causing irreversible changes to earth and dramatic changes to weather patterns

Aim/objective

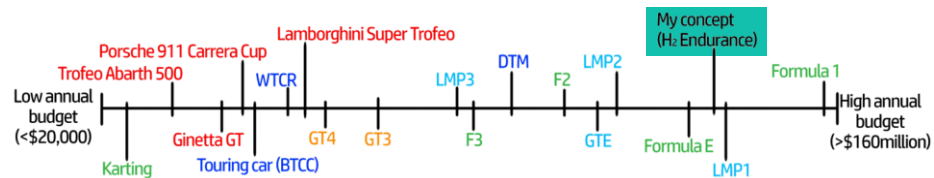
- The objective of the series is to promote sustainability and encourage the people who watch the sport to make changes, big or small, to their lives to live in a more sustainable and environmentally friendly
- The main aim for this project is to design a car that will push for global sustainability and the use of hydrogen fuel cells in the transport industry

Research findings

Performance Benchmarking

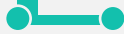



Cost Benchmarking





Key: - Customer Racing - Touring Cars - GT Racing - Endurance Racing - Single Seater

Vehicle specific

- 

- The vehicle will have a hydrogen electric powertrain, made up of 4 motors and supercapacitors with a hydrogen fuel cell. Allowing the car to travel as far as a similar ICE version
- 

- The major materials used on the car will be; recycled carbon fibre for the structural monocoque, a carbon fibre and flax fibre composite for the body panels, and titanium for suspension and drivetrain elements
- 

- Production methods for the vehicle will be sustainable batch production, which combines the positives from both small and large scale production methods
- 

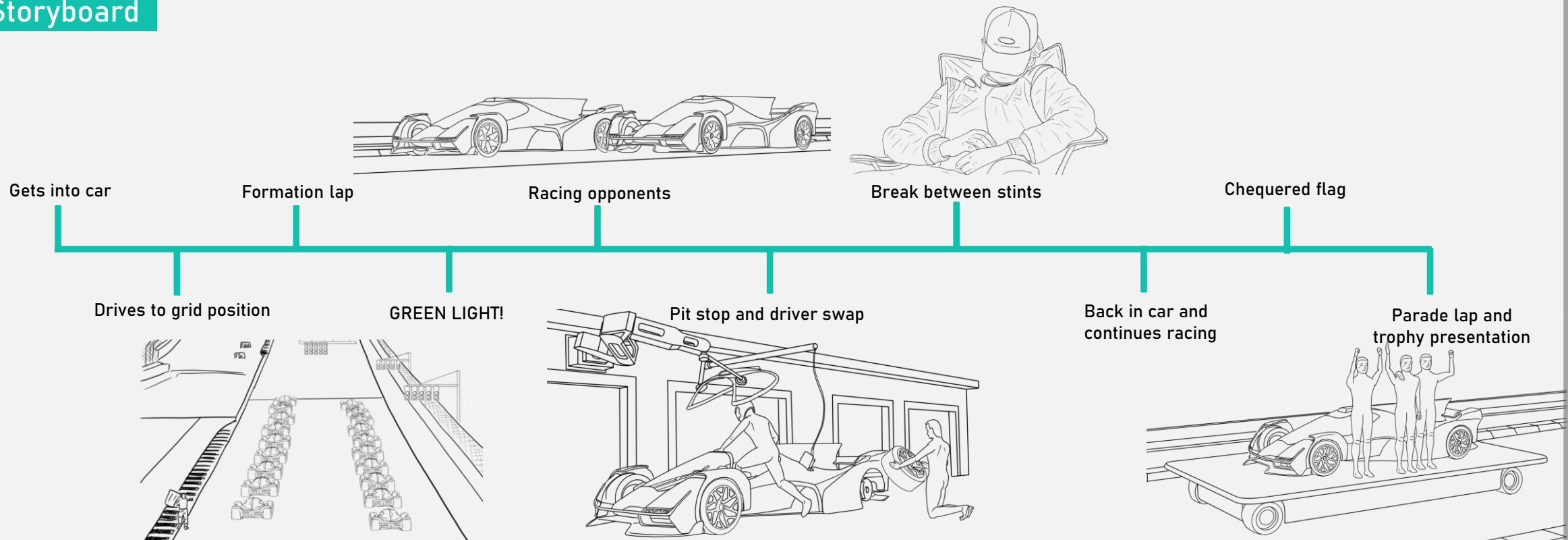
- The vehicle usage will be global racing at tracks in almost every continent and making the series available to a wide variety of people around the globe.

Driver persona



- 18-35
- Any gender and ethnicity
- Has racing experience at a high level
- Uses social media to encourage sustainable living
- Sponsored by brands that make sustainable products

Storyboard

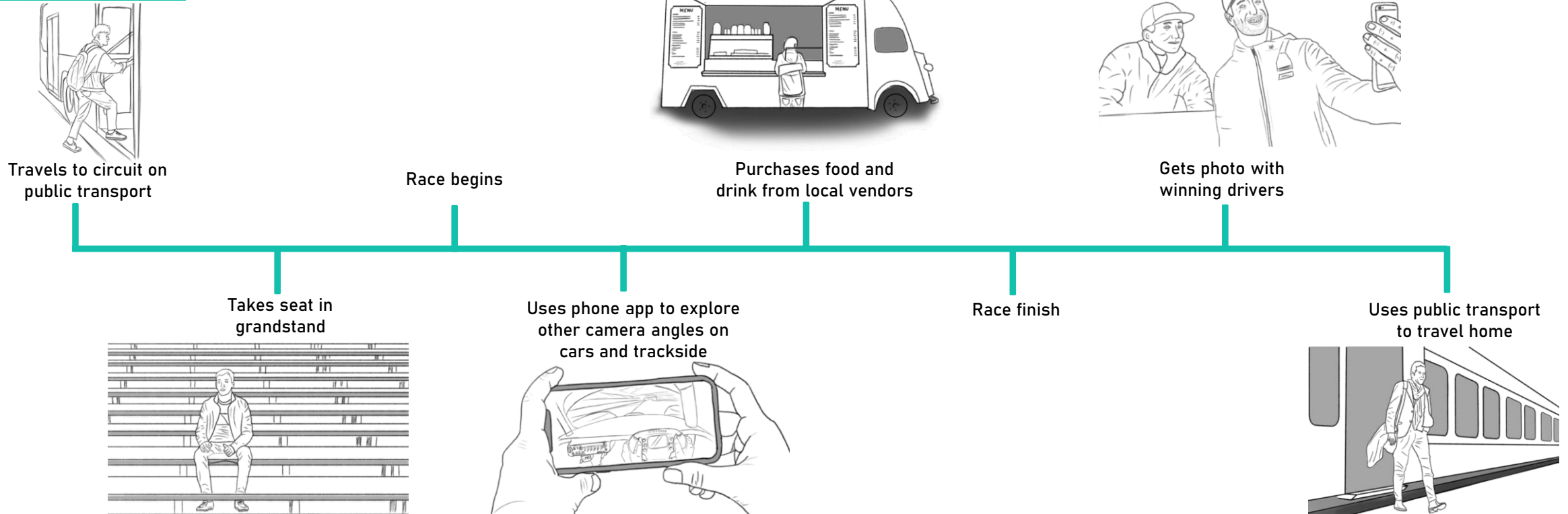


Spectator persona

- 3-99
- Any gender and ethnicity
- Motorsport fan
- Wants to protect the planet for future generations
- Buys as many sustainable or locally sourced products as possible



Storyboard



Initial sketches

Form inspiration

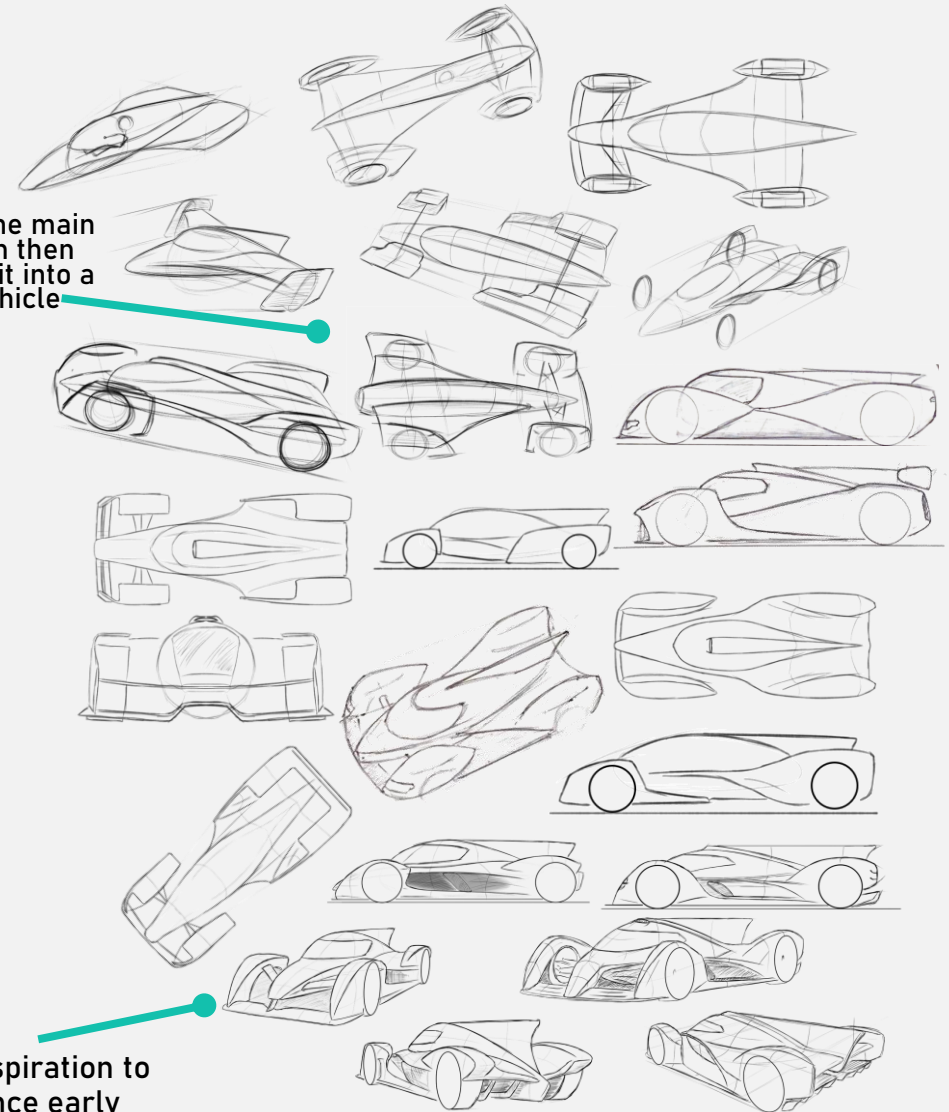


Benchmarking



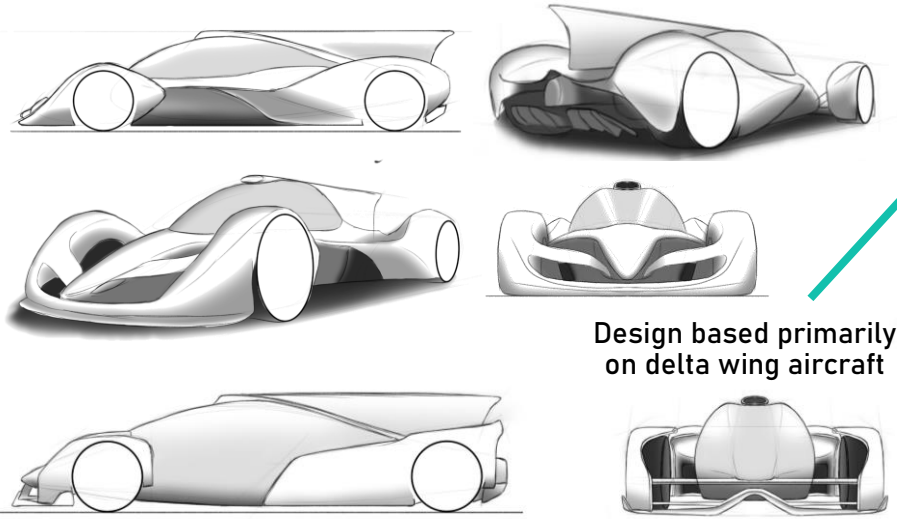
Initial Development

Exploring the main inspiration then developing it into a rough vehicle

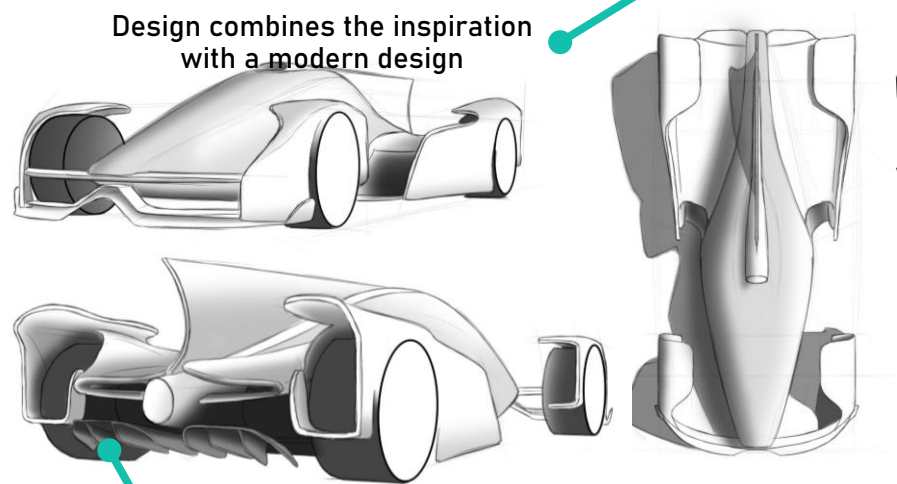


Form inspiration to influence early design ideas

Design Development

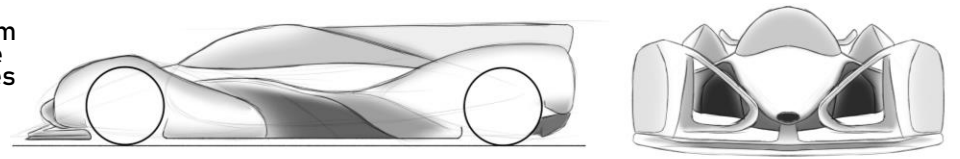


Design based primarily on delta wing aircraft

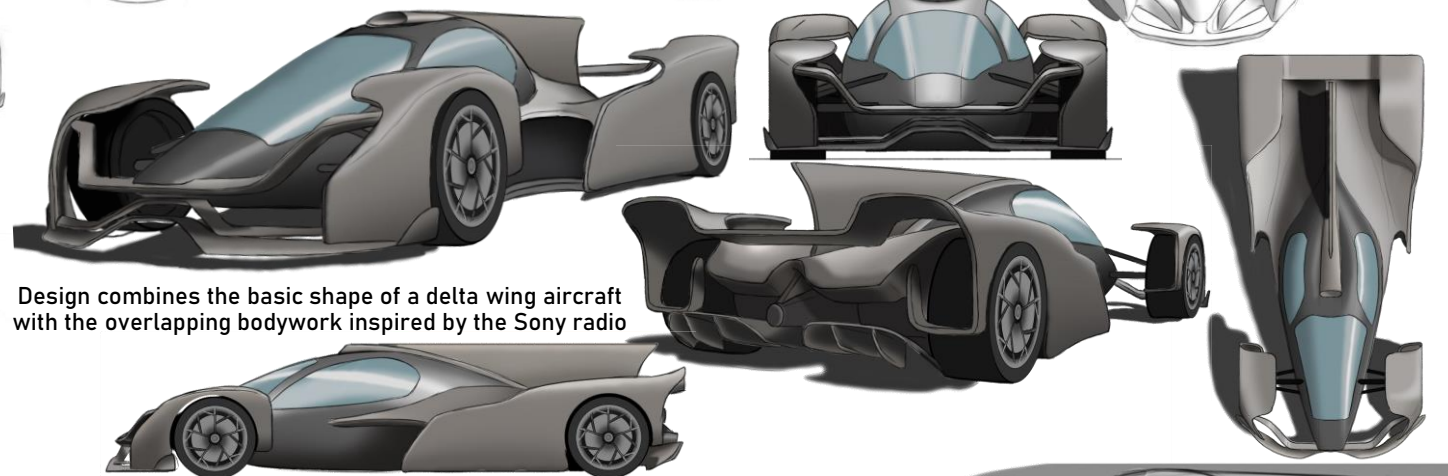
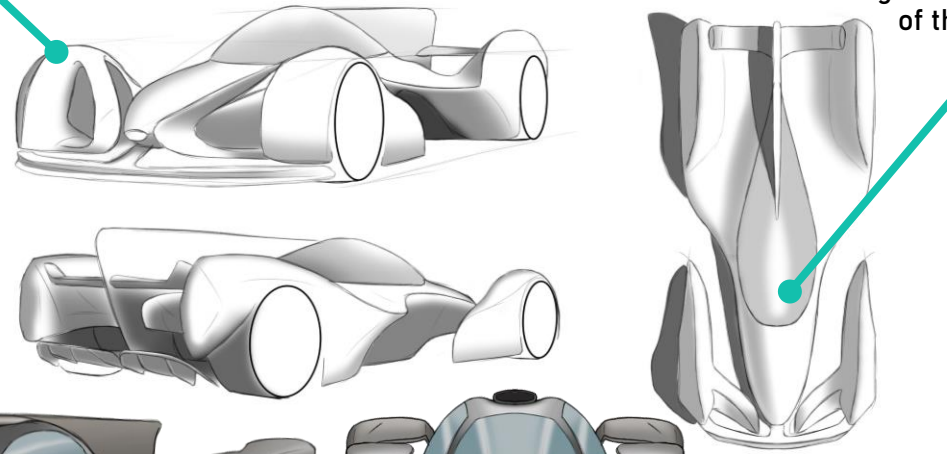


Design combines the inspiration with a modern design

More organic form compared to the inspiration images

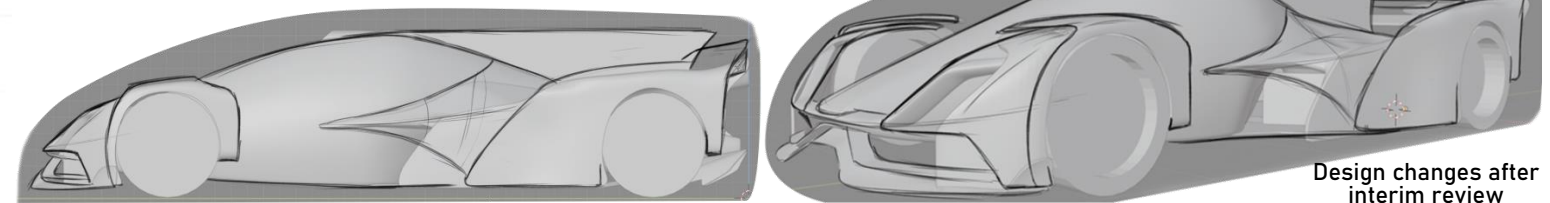


Single seat version of the car



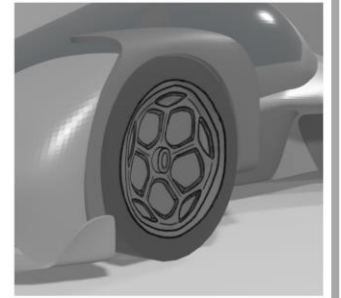
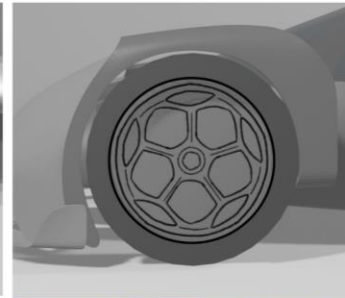
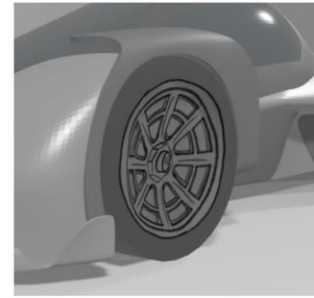
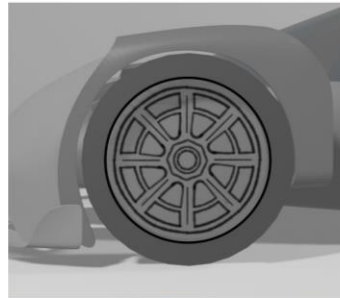
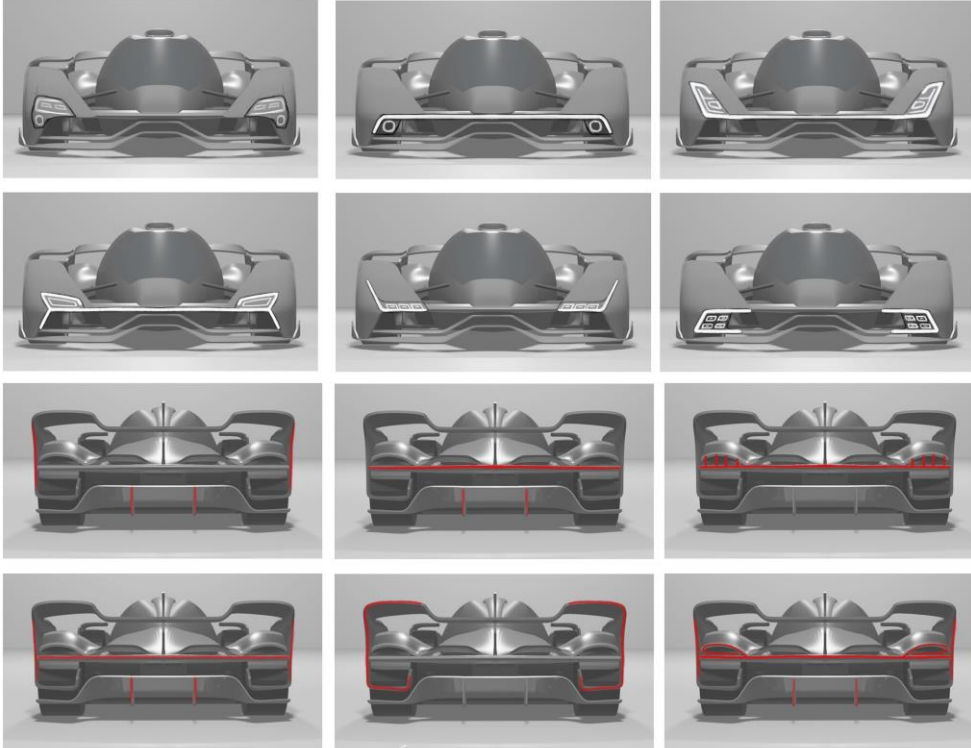
Design combines the basic shape of a delta wing aircraft with the overlapping bodywork inspired by the Sony radio

Chosen design direction that will be further developed



Design changes after interim review

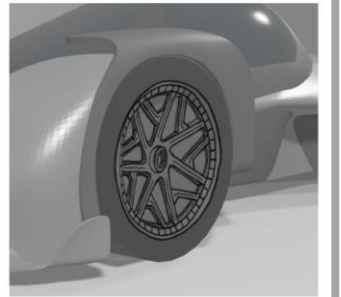
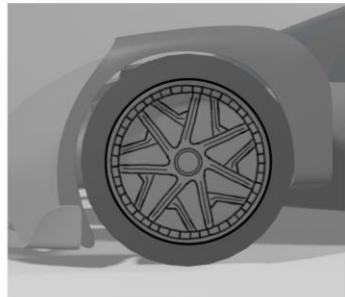
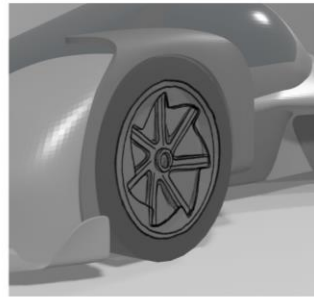
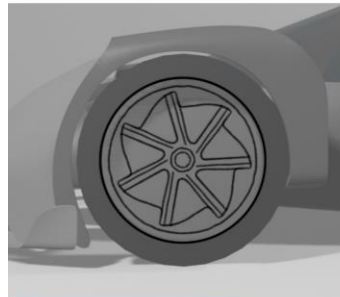
Detail Development



Spiderweb



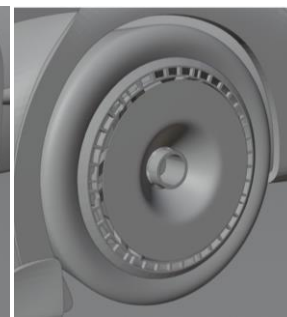
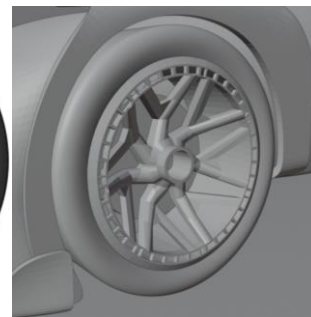
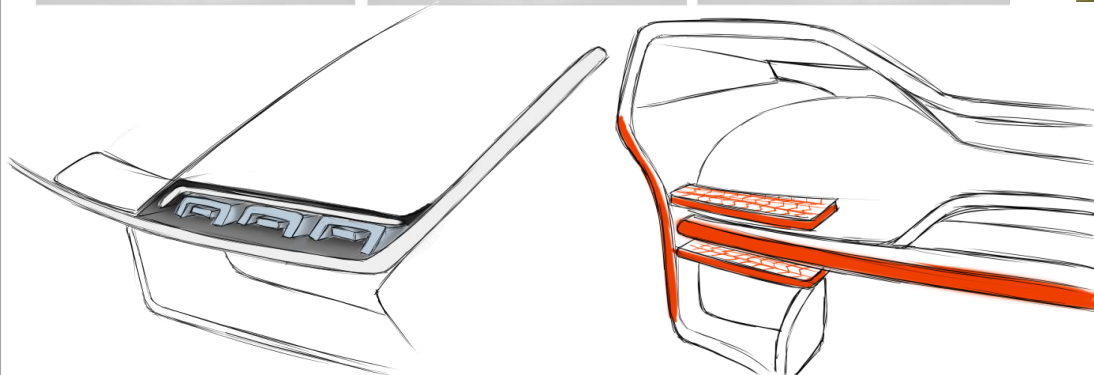
Okra



Windmill



Hexagonal Pattern.

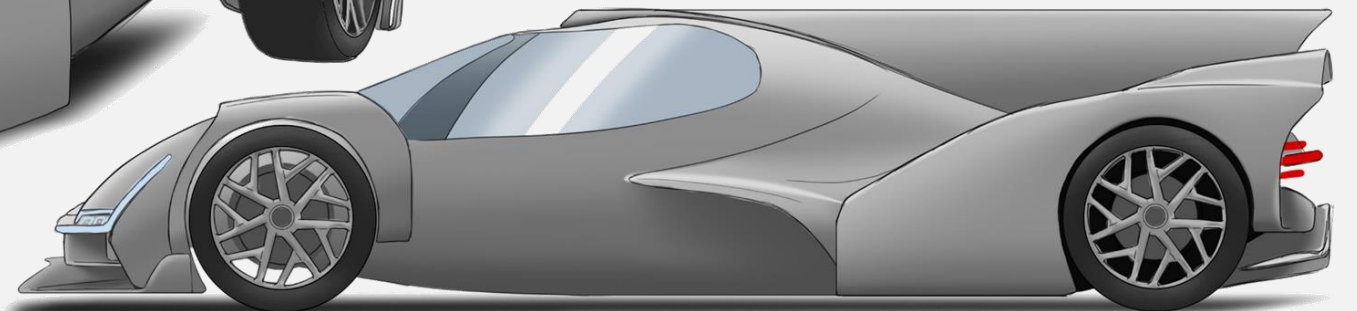
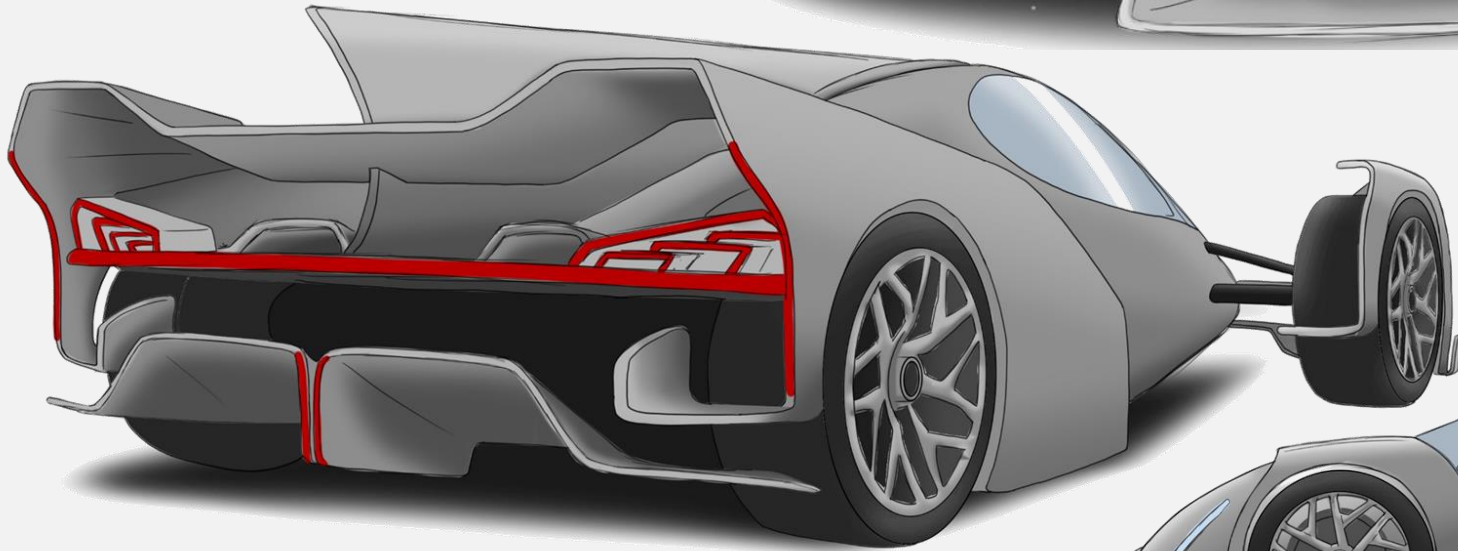
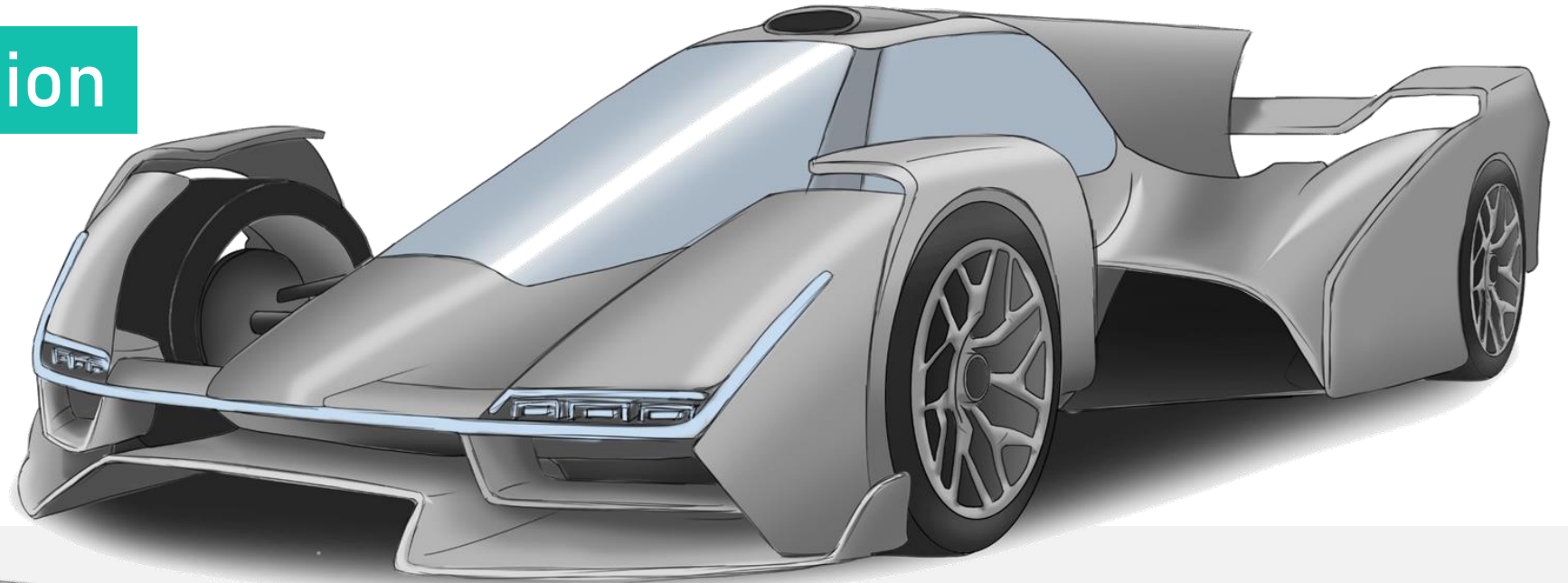


Inspiration behind Turbo Fans.



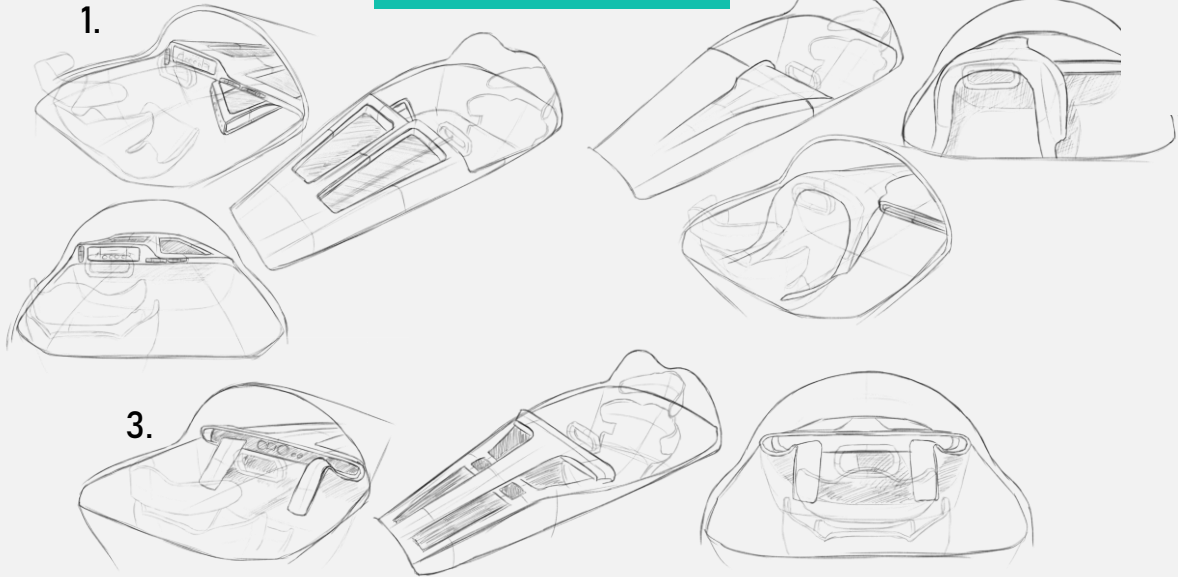
Porsche 962

Chosen direction

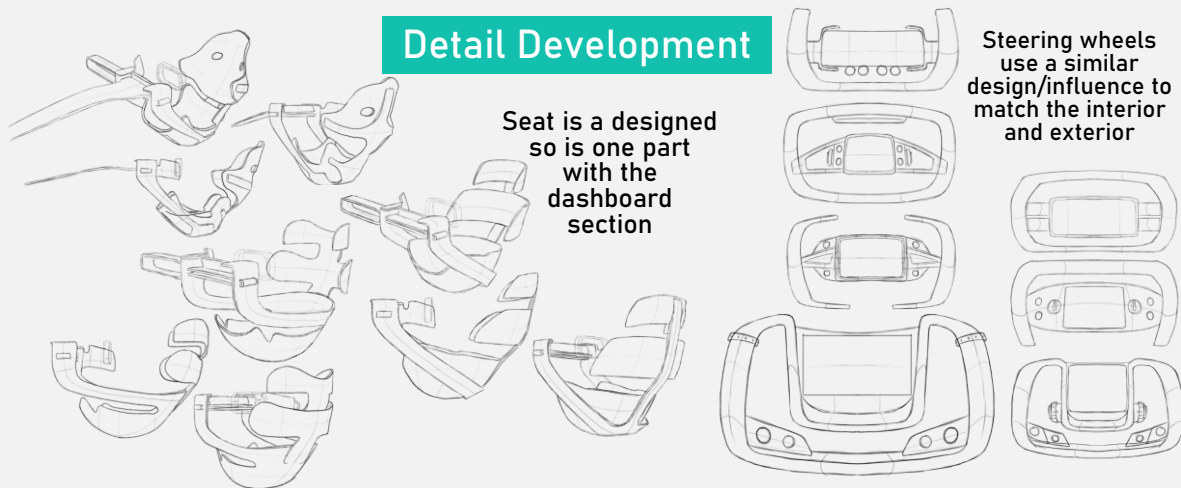


Interior direction

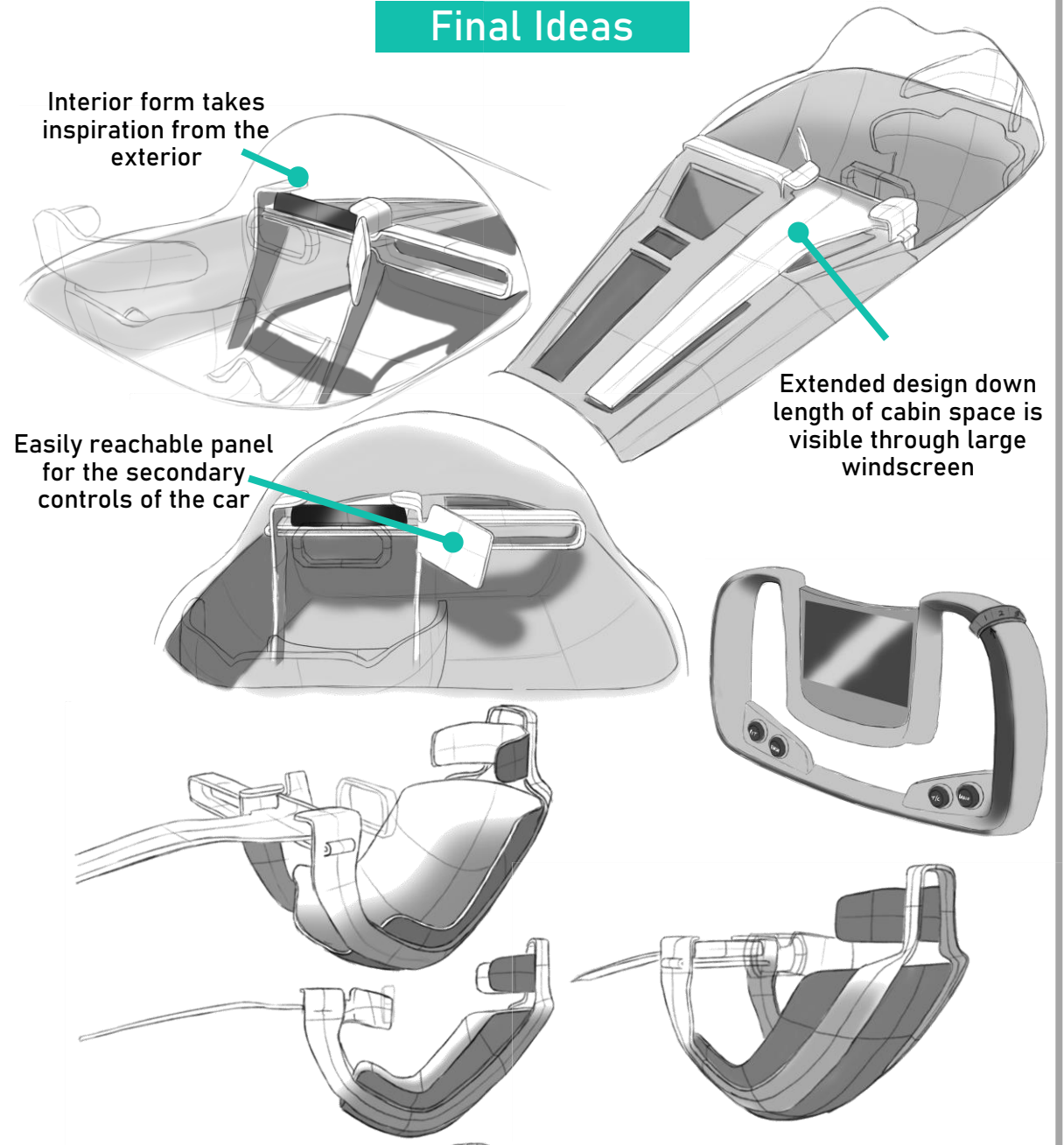
Initial Development



Detail Development



Final Ideas



CMF

Materials

Construction -

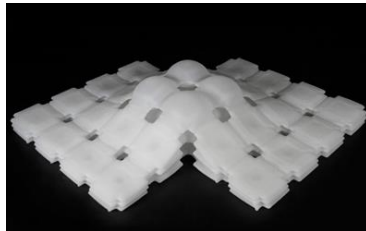
- A recycled carbon fibre monocoque will provide a rigid pod for the driver and will protect them in the event of a serious accident
- Other parts of the car that make up the design will be made from a hemp fibre and carbon fibre composite

Functional -

- The suspension and drivetrain components will be made from more traditional materials like titanium, and lightweight aluminium to house the parts that make up the large electrical and drivetrain components

Interior -

- a 3D printed inflatable material will be used on the seat so drivers don't need to swap their seat moulds during a pit stop and the seat can be automatically adjusted to the right drivers body shape



Finishes

Paint -

- Colour will be applied to the cars using eco-friendly automotive paint because it is water based.
- Water based paints gives more coverage compared to solvent paints, this means less paint is needed to cover the car and less layers of paint are needed to give a tidy finish

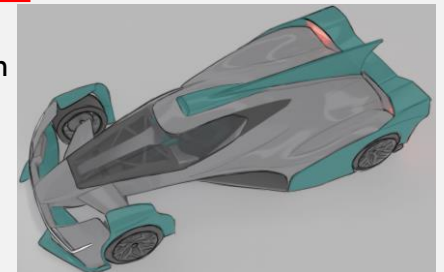
Decals/Graphics -

- Decals will be applied to the car using non-PVC vinyl. Non-PVC vinyl can be recycled after use.
- Non-PVC vinyl is also made up of better-quality materials than PVC wraps so adds to the durability of the material especially when applied to a race car

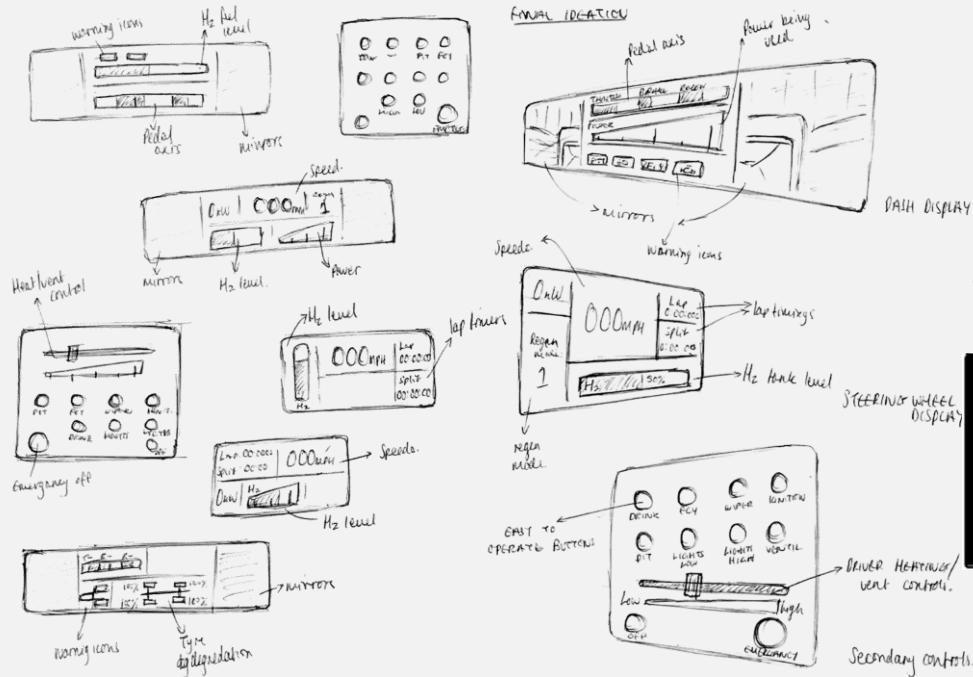
Livery/colour ideas



Chosen livery style with colours adapted to match the racing series logo



HMI design/UX - Driver



Steering wheel display



Secondary controls



Simple controls so driver doesn't take their eyes off the track for long durations

Hydrogen fuel tank level

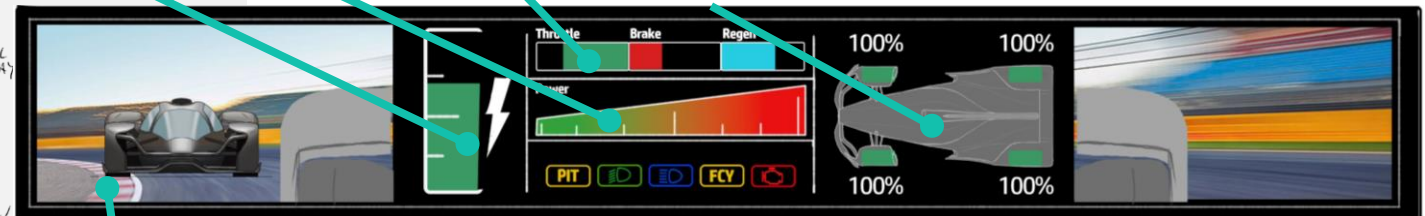
Supercapacitor charge

Power output of car

Pedal axis

Tyre degradation

Dashboard display



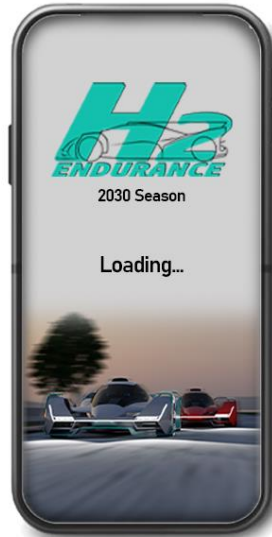
- During a pit stop the driver change is simplified by a robot arm lifting the canopy off the car allowing the more space for the driver to get in and out the car easier.
- The seat is also constructed using inflatable polymers, the means a drivers seating position can be saved reducing the need for swapping seat moulds



- At the end of the race the winners get taken round the track for a parade lap on an autonomous podium so that they can share the victory with the crowd.

HMI Design/UX - Spectator

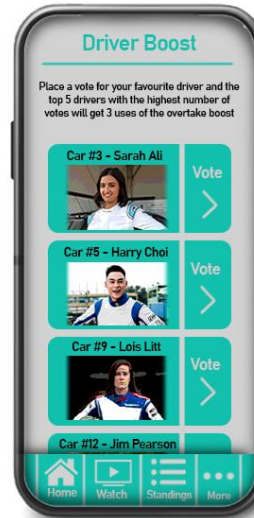
App for the spectators and fans mobile phones so that they can interact with the race series, and also watch live from at home or trackside



Loading screen



Home page



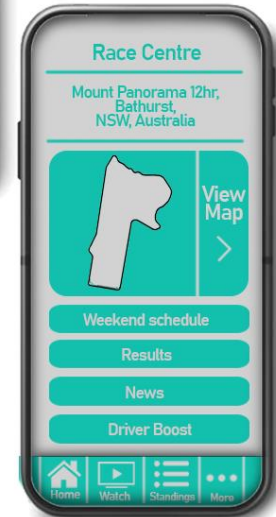
Driver boost page



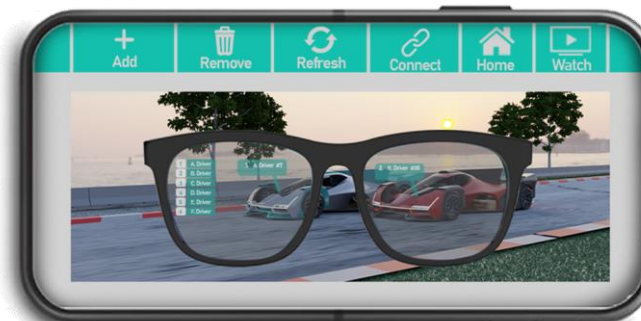
E-ticket page



Ways to watch

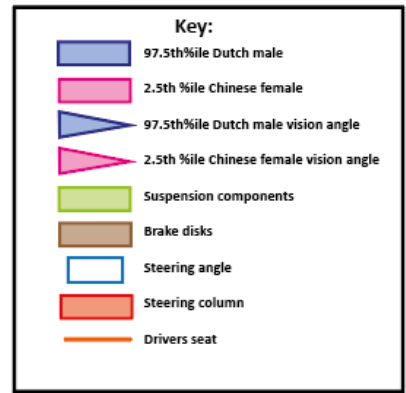
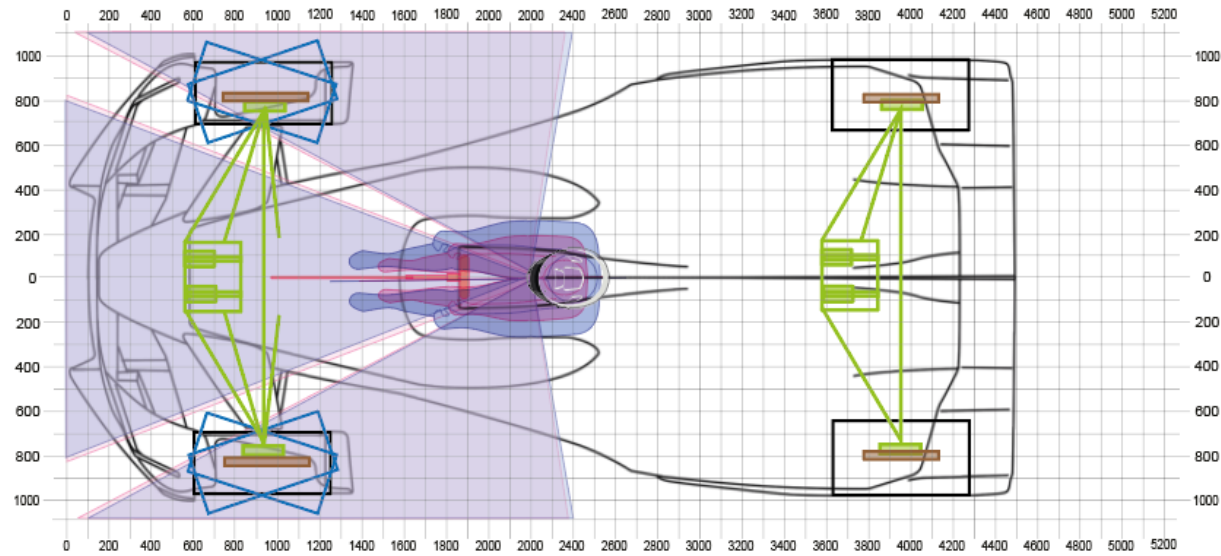


Race centre page

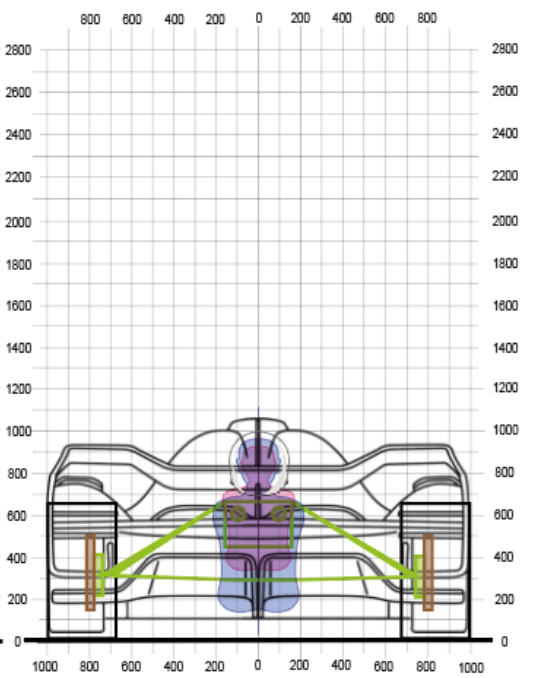
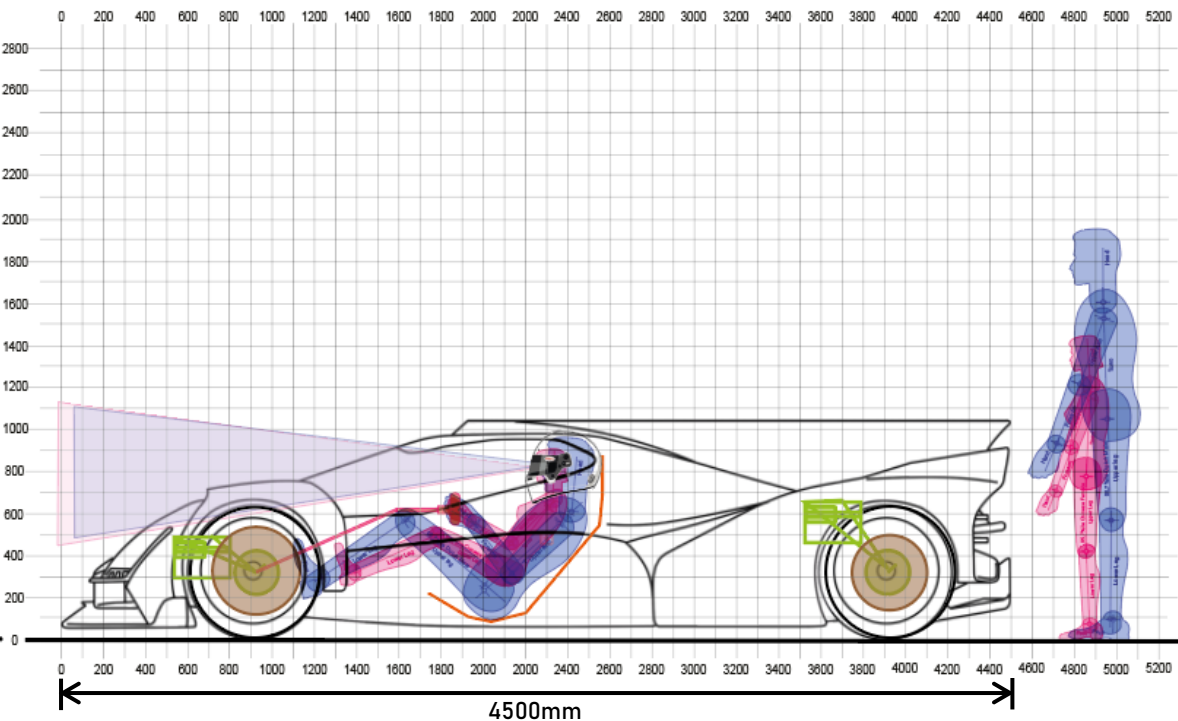
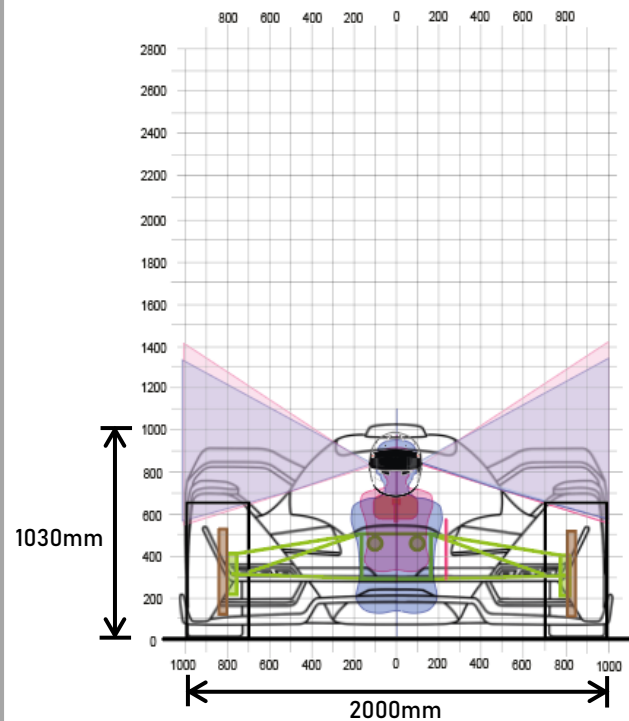


AR glasses available for the spectators. They have a customisable UI done on the mobile app

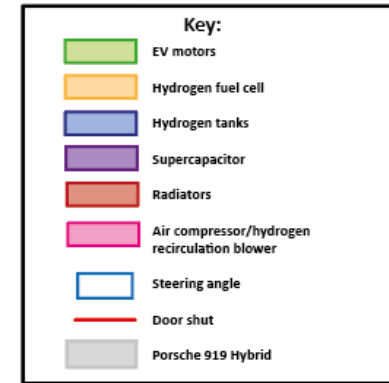
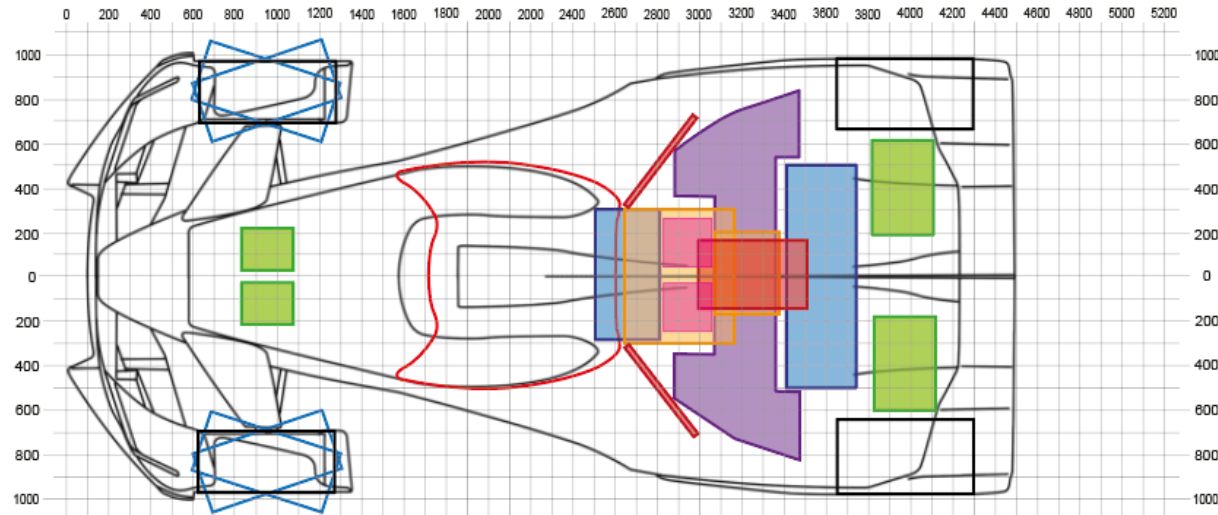
Package drawing



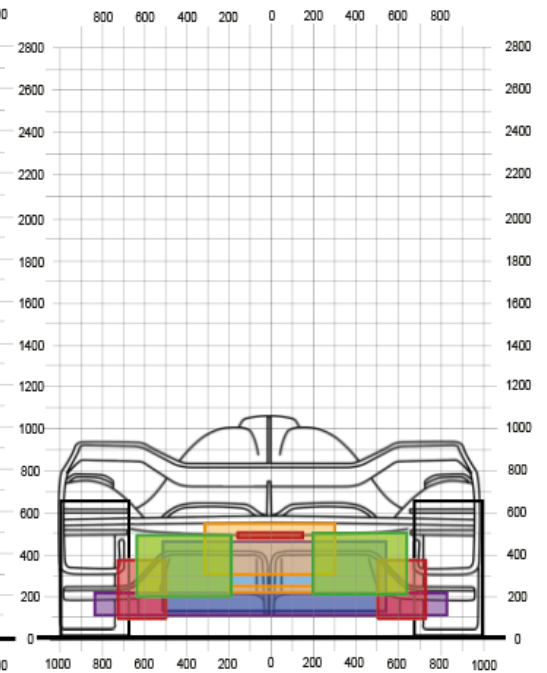
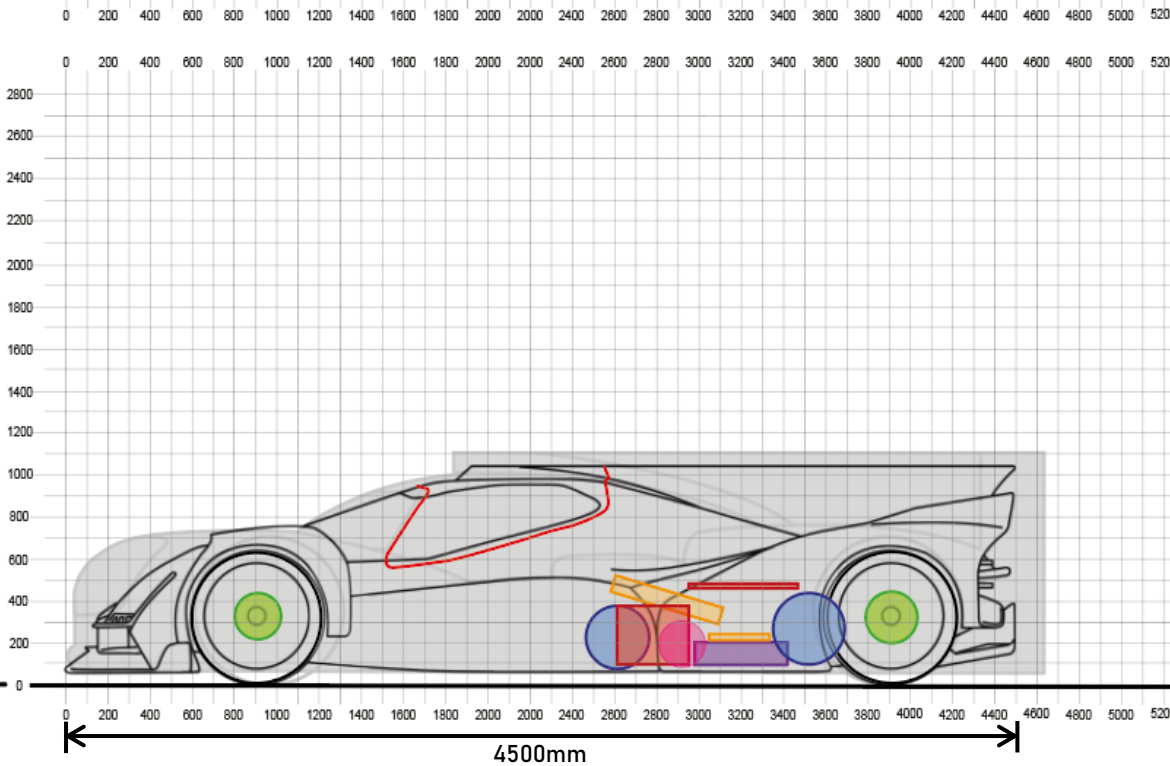
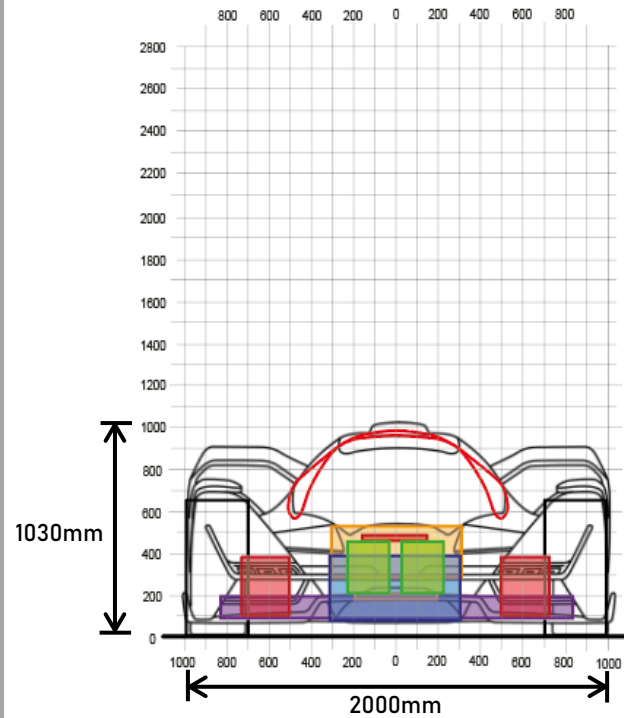
scale 1:10



Package drawing

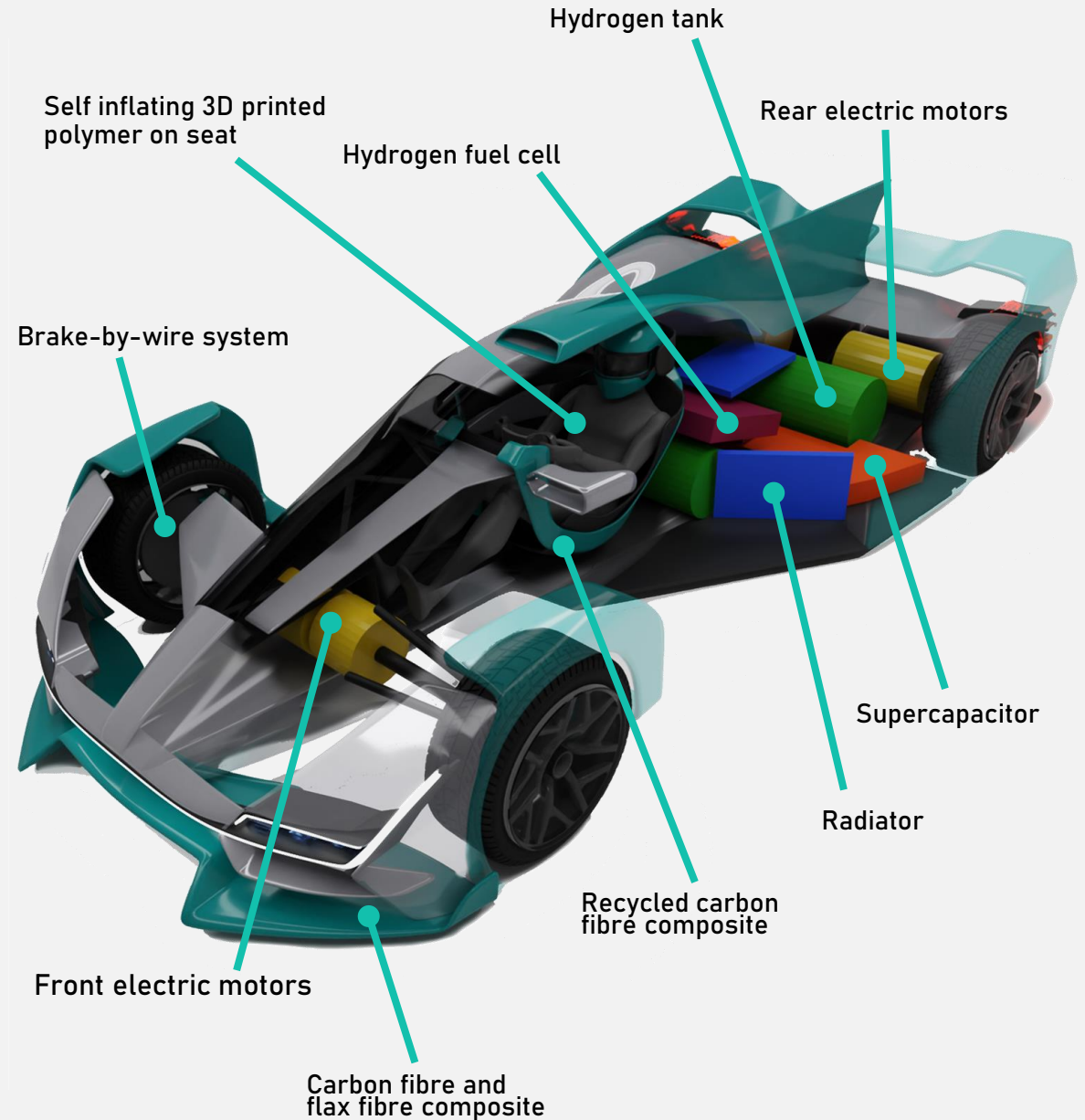


scale 1:10

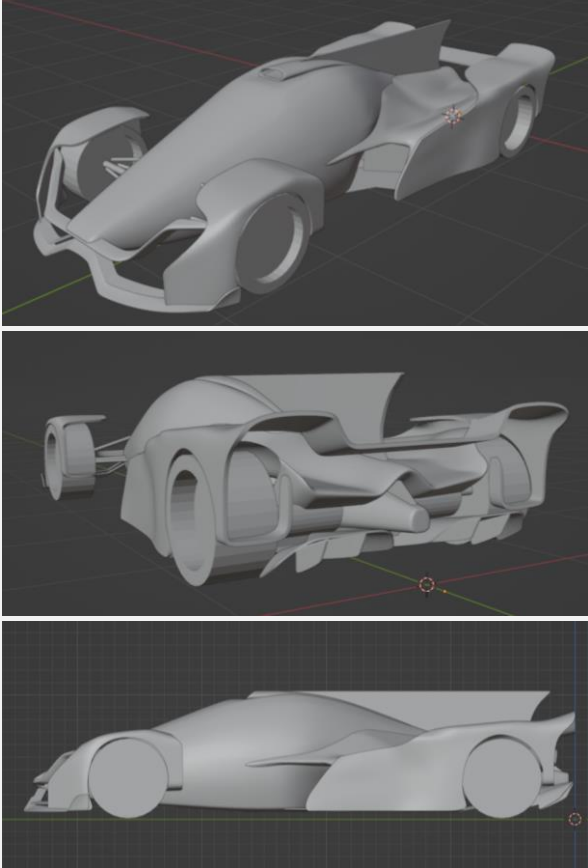


Technical content

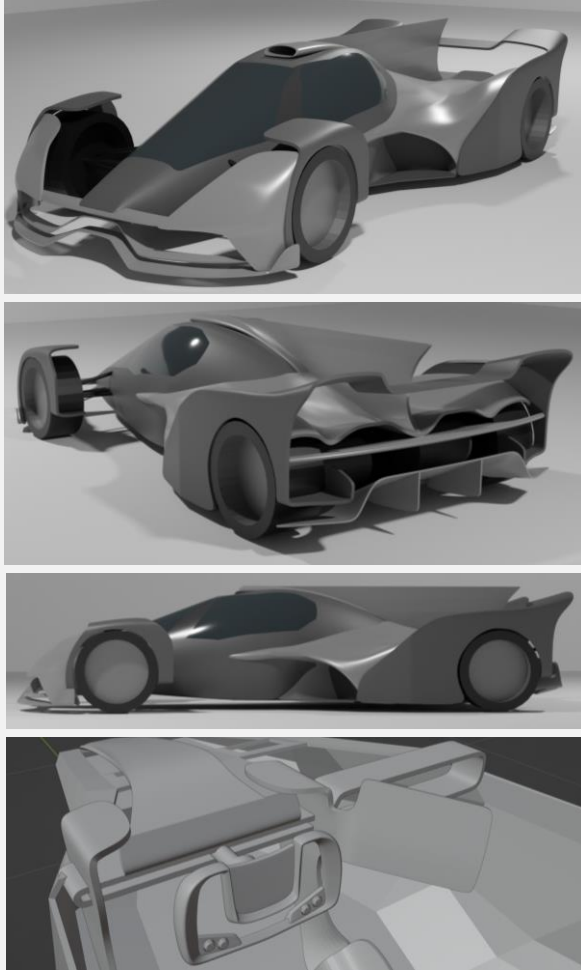
Chassis	
Monocoque	Moulded recycled carbon fibre composite
Bodywork	Carbon fibre and Flax fibre composite
Front suspension	Carbon fibre wishbone and pushrod-activated torsion springs and rockers
Rear suspension	Carbon fibre wishbone and pull-rod activated inboard springs and dampers
Steering	Rack and pinion with power assist
Electronics	FIA homologated ECU and electrical system
Tyres	Michelin Pilot Sport EV - all weather tyre
Wheels	Forged magnesium
Occupancy	1 (but space for 2)
Powertrain	
Hydrogen fuel cell	Developed by Toyota Motor Corporation
EV motors	x2 AXL_560 by Rimac Automobili (maximum 560Nm torque and 440kW/590hp each)
Supercapacitor	Developed by Cellergy
Fuel	Hydrogen-electric
Hydrogen fuel tank	Recycled carbon fibre shell lined with a high molecular polymer
Hydrogen tank capacity	5.6kg
Top speed	210mph
Range	300-350miles
Dimensions	
Overall length	4430mm
Overall width	2000mm
Overall height	1030mm
Wheel base	3000mm
Manufacture	Sustainable batch production



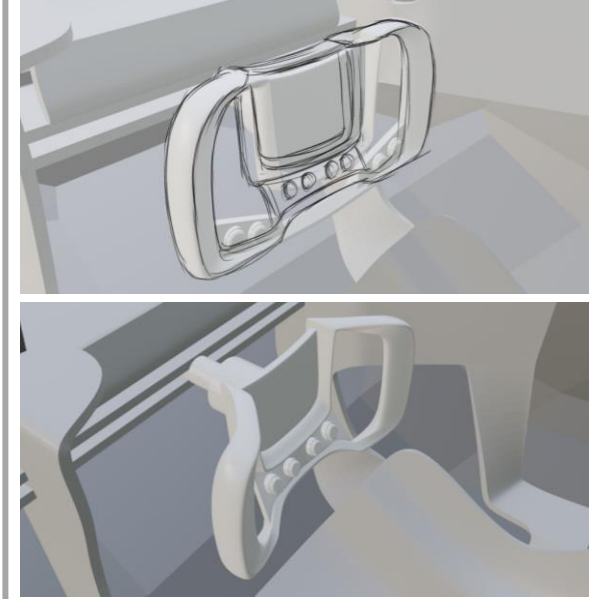
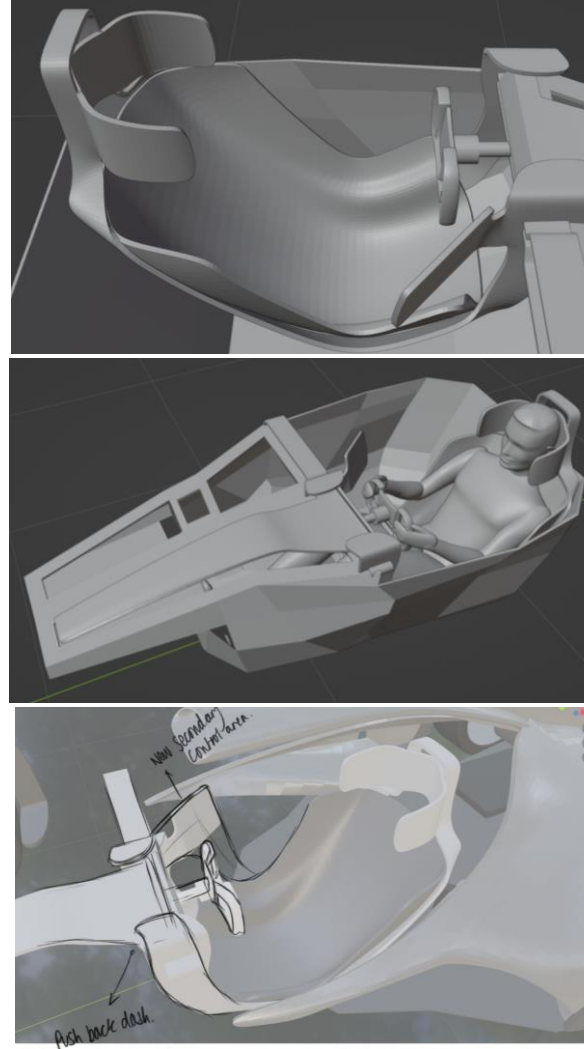
3D Development- Blender



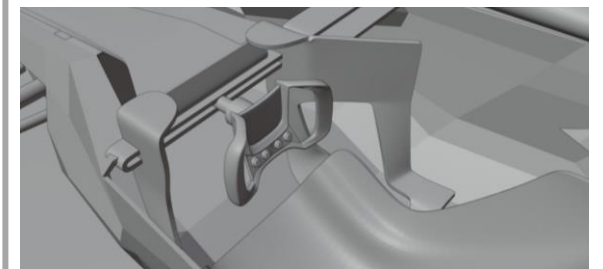
Rough model for the design at the interim review to better visualise the form and how the surfacing works



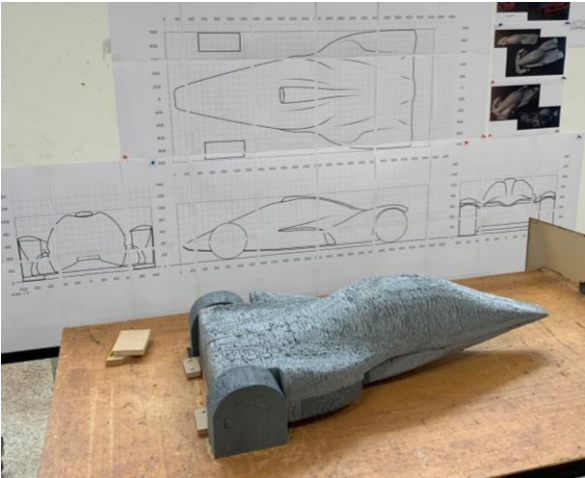
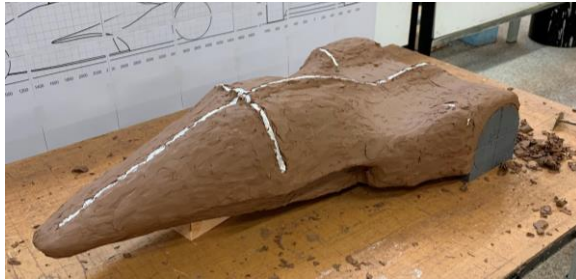
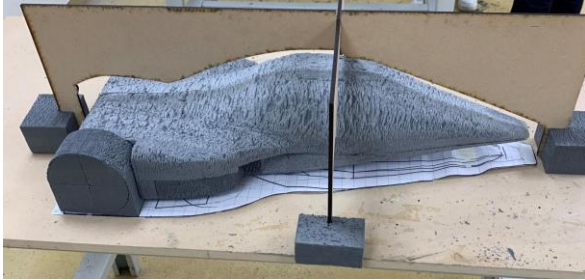
Updated design direction from interim review feedback



Updated interior design changing the form of the interior elements to better suit the exterior design



3D Development- Clay



Loading onto the armature to fill the gap between the foam and silhouette of the design.

Early surfacing of the design to show the where the silhouette is and the point to load clay to

Clay modelling process started with armature construction made from foam using the package drawing of my design printed off the correct scale. The foam was smaller than the actual size to allow for about 10mm of clay to allow room for sculpting



Initial surfacing of the loaded clay and surfacing the bottom of the model



Surfacing the clay and adding the design details such as the roof scoop and rear aero channel exits.

Also making the side intakes deeper so further communicate the design effectively

3D Development- Clay



Final design but not fully surfaced

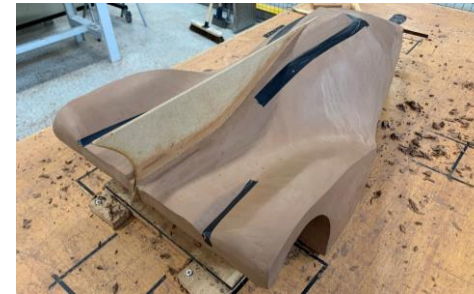


Forming the new design and early surfacing to it, and adding the fin

Testing out the fitment of the extra rapid prototype parts the go with the design



After feedback given the new design sketched over the model to improve the form.
New design means that the driving position is moved to the centre



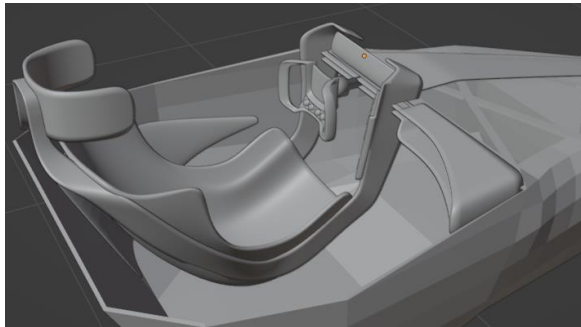
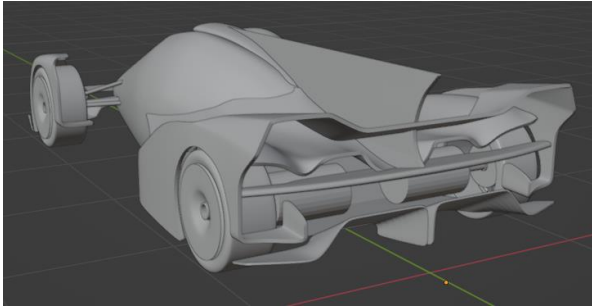
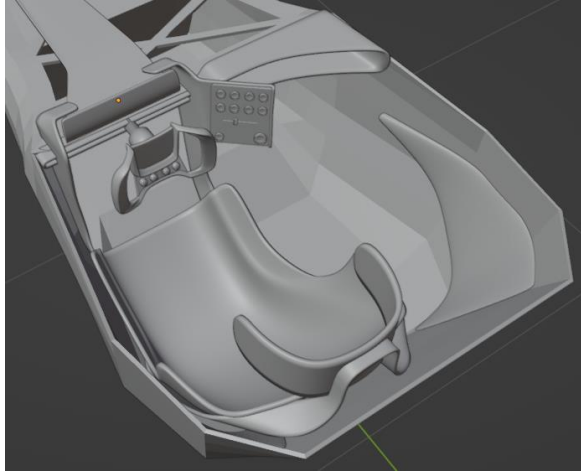
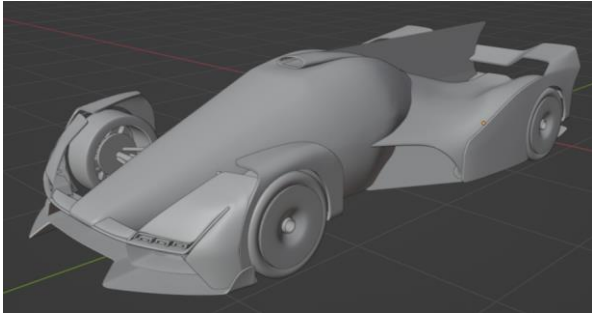
Finalising the body surfacing and tidying the roof scoop and aero channel exits

Adding the piece through the nose to support the front rapid prototype parts

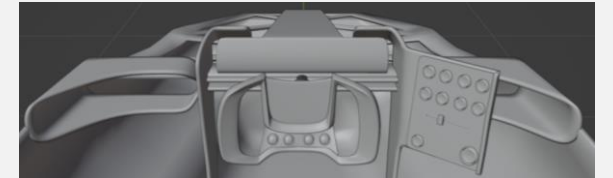
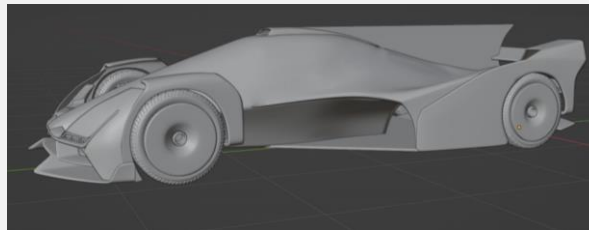
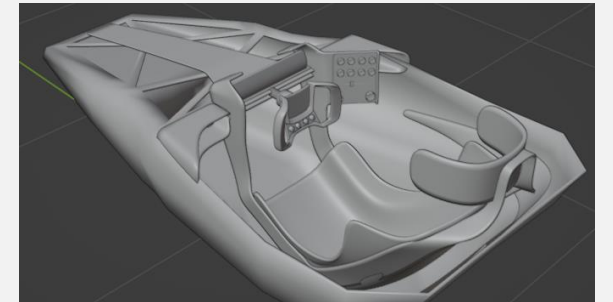
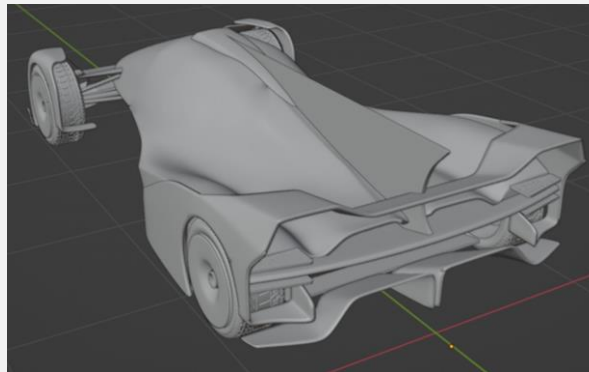
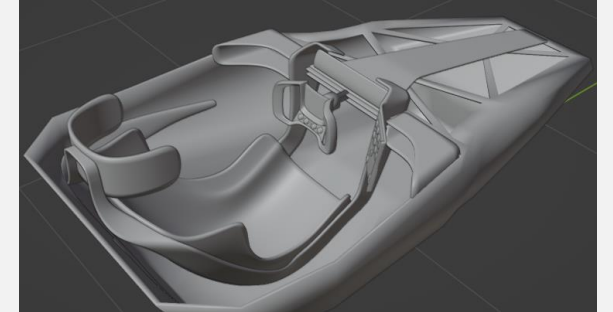
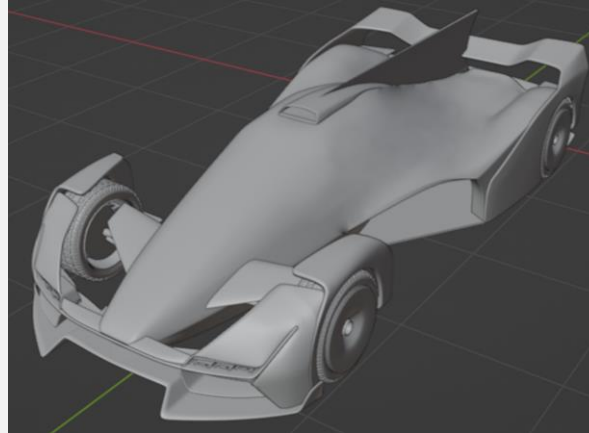


Adding final details to the roof scoop along with the DLO line to the cockpit and adding the painted rapid prototype parts.

3D Development- Blender

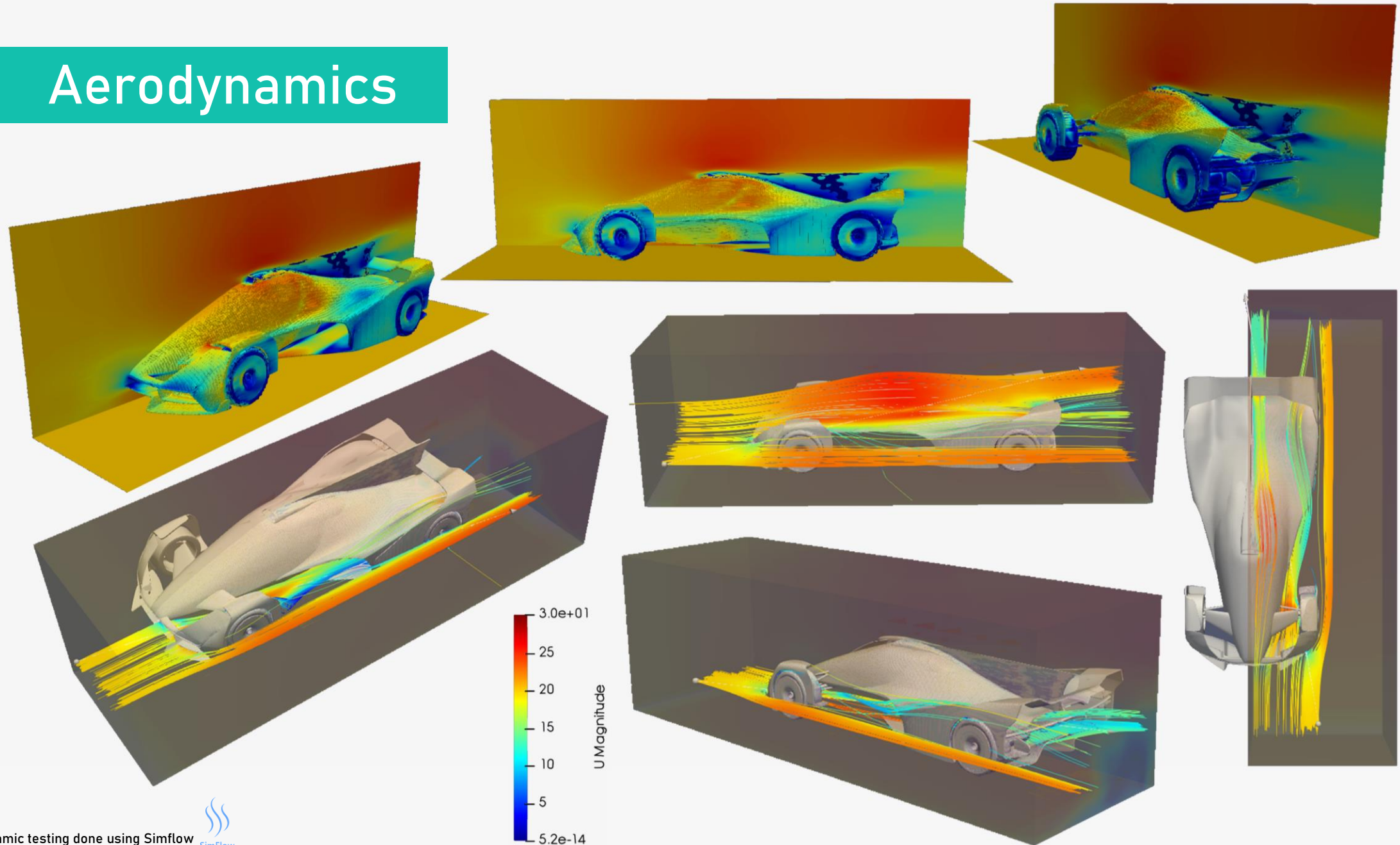


Final design direction prior to the clay modelling process to help with surfacing visualisation

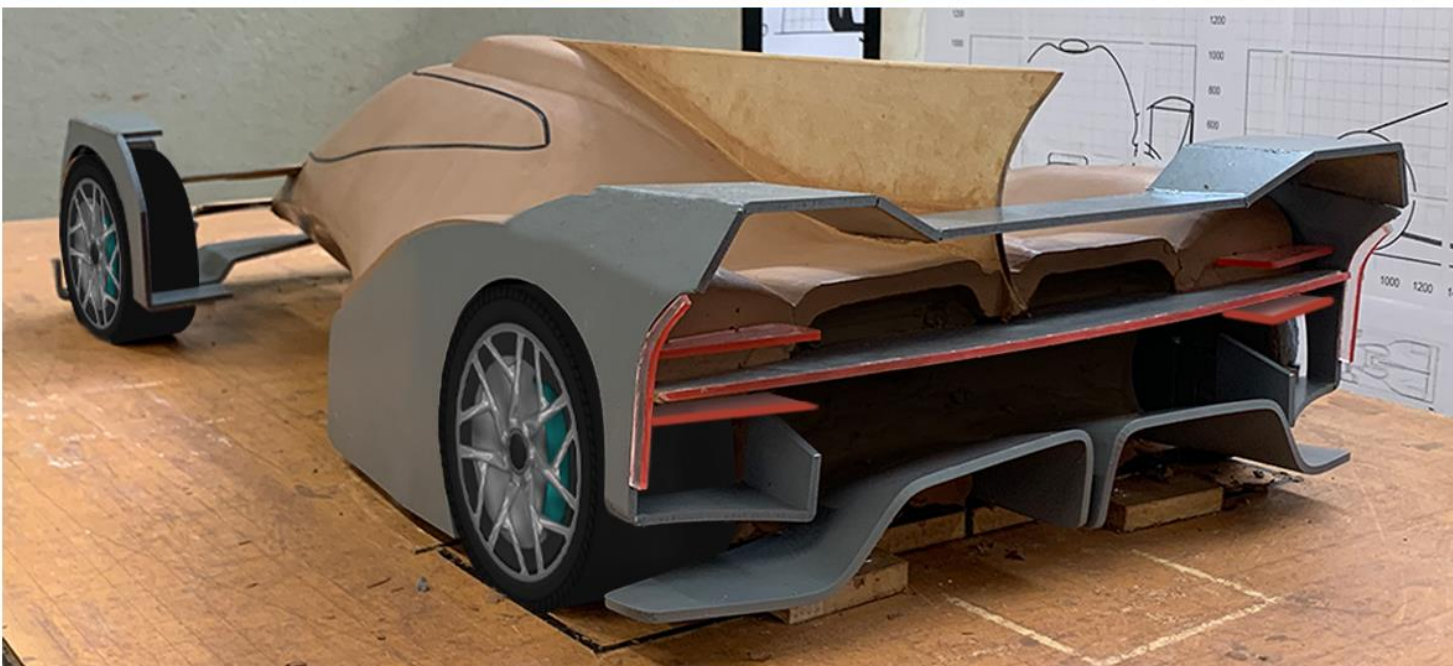
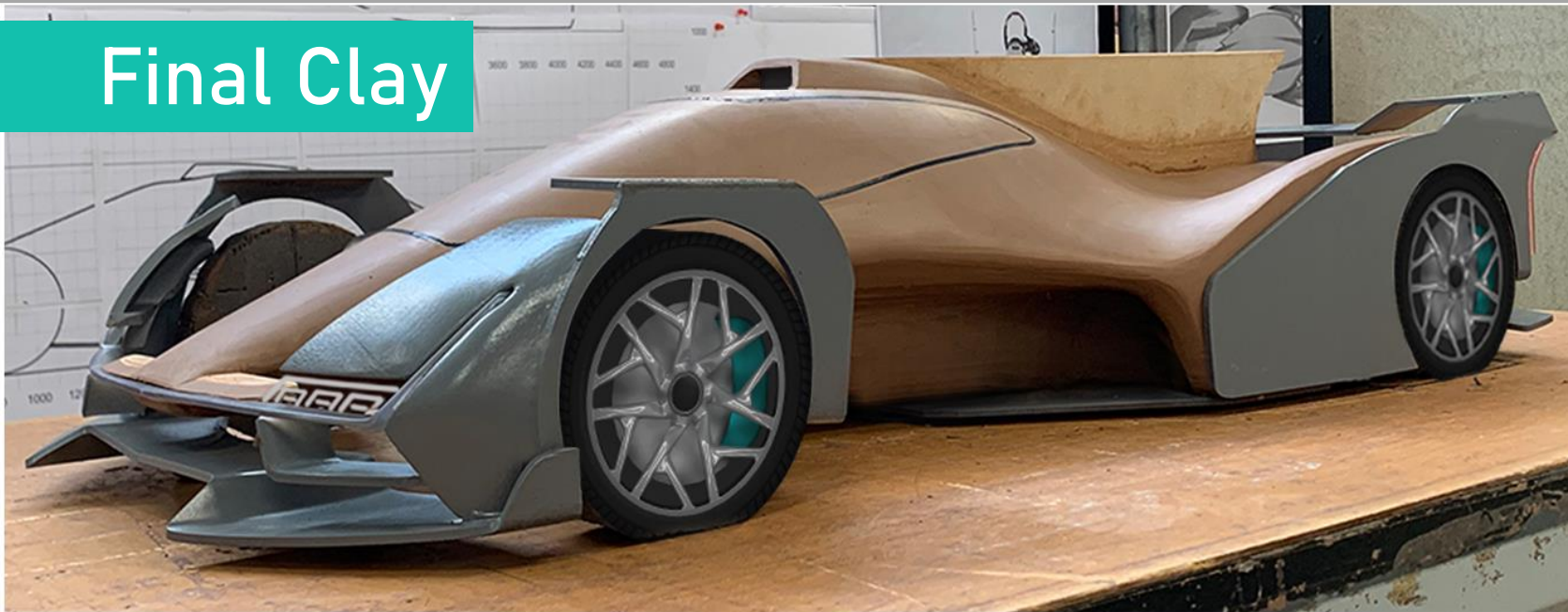


Updated design after the clay modelling development with a more sculpted underside of the cabin and a revised central driving position

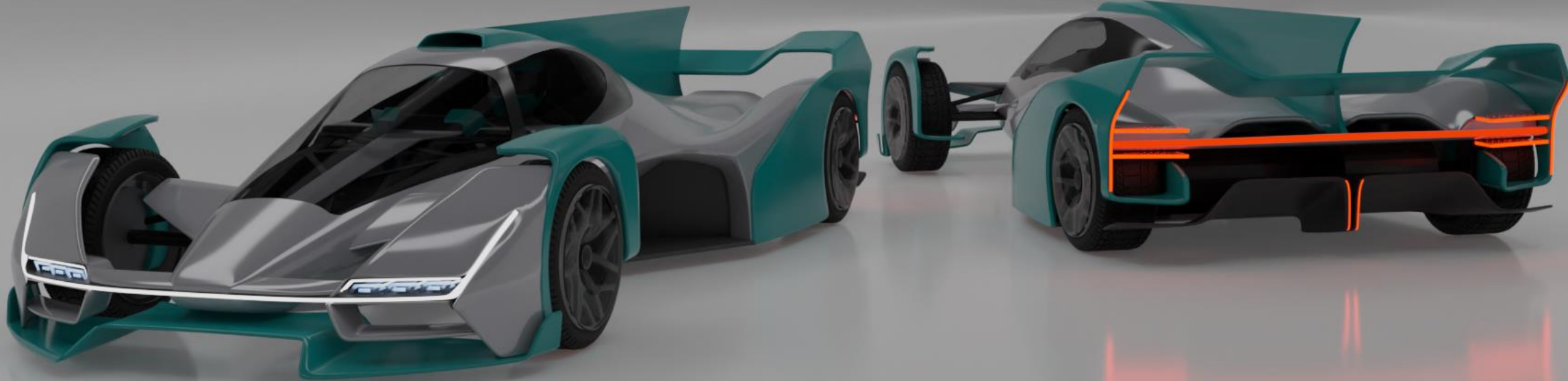
Aerodynamics



Final Clay



Final Blender



Final Blender



'Hero render'

