Interior design concept for a community car utilizing photosynthesis

Image 1 (Adapted McKay 2020)

LAB University of Applied Sciences
Institute of Design
Degree Programme in Design
Vehicle design
Bachelor's thesis
Pages 64

Veena Koskinen

leef - Interior design concept for a community car utilizing photosynthesis

Spring 2021

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Abstract

This graduation work considers possibilities to use photosynthesis and its end products in the interior design of a vehicle. The future of photosynthesis technology and its possibilities are explored through interviews, and from literature.

The concept is for the 10 to 20 years into the future, where photosynthetically made reusable materials and fuel production could be operated on a bigger scale. At present the photosynthetic production technology only works at the laboratory scale. For it to be possible to use photosynthetic materials and fuels in vehicle interiors, the photosynthetic process must be modified to create desired end products more effectively and on a larger scale. However, in the future it could be possible to develop this technology to be more efficient on a smaller scale.

The concept is situated in Australia due to environmental factors like temperature and day light hours. A survey was used to collect information on Australian traffic and commuting habits. The survey was answered by 11 locals that live close to the largest cities of Australia. The survey revealed that in Australia the traveling distances are long, and the most common form of transportation is a car. Taxis and ride-share taxi services are frequently used when passengers are unable to drive for themselves or during the weekends when public transportations is not running. Because of the survey and a discussion with a local, decision was made to change the direction of the concept to a community car.

An interior design concept that uses multiple different ways to utilize photosynthesis and its end products was created. The concept includes a plant wall that generates energy from the Sun using plant-microbial fuel cell technology, PMFCs. The floor of the vehicle participates in the generation of energy through photosynthesis. Additionally, the interior consists of different materials the production of which used the end products of photosynthesis. The light intake of the interior has been a top priority to maximise the benefit of solar energy for the plants and organisms using photosynthesis. The shapes and colours of the interior design where strongly inspired by the nature and leaves of plants.

Keywords

Community car consept

Car interior

Photosynthesis

Future

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Tiivistelmä

Tässä valmistumistyössä tarkastellaan mahdollisuuksia käyttää fotosynteesiä ja sen lopputuotteita ajoneuvon sisustussuunnittelussa. Fotosynteesitekniikan tulevaisuutta ja mahdollisuuksia tutkitaan haastattelujen ja kirjallisuuden avulla.

Konsepti sijoittuu 10–20 vuotta tulevaisuuteen, jossa fotosynteettisesti valmistettuja uudelleenkäytettäviä materiaaleja ja polttoaineiden tuotantoa voitaisiin käyttää laajemmassa mittakaavassa. Tällä hetkellä fotosynteettinen tuotantotekniikka toimii vain laboratorion mittakaavassa. Jotta fotosynteesillä tuotettuja materiaaleja ja polttoaineita voitaisiin käyttää ajoneuvojen sisätiloissa, fotosynteesiprosessia on muunnettava haluttujen lopputuotteiden luomiseksi tehokkaammin ja laajemmassa mittakaavassa. Tulevaisuudessa voi kuitenkin olla mahdollista kehittää tätä tekniikkaa tehokkaammaksi pienemmässä mittakaavassa.

Konsepti sijoittuu Australiaan sen ympäristötekijöiden, kuten lämpötilan ja päivänvalo ajan vuoksi. Kyselyä käytettiin keräämään tietoa Australian liikennekulttuurista ja työmatkoista. Kyselyyn vastasi 11 paikallista, jotka asuvat lähellä Australian suurimpia kaupunkeja. Kysely paljasti, että Australiassa matkustus etäisyydet ovat pitkiä, ja yleisin kulkumuoto tämän vuoksi on auto. Takseja ja jaettuja taksipalveluja käytetään usein, kun matkustajat eivät pysty ajamaan itse tai viikonloppuisin, kun julkinen liikenne ei ole käynnissä. Kyselyn ja paikallisen kanssa käytyjen keskustelujen takia konseptin suunta päätettiin muuttaa yhteisöautoksi.

Lopputuloksena luotiin sisustussuunnitelma, joka käyttää useita fotosynteesin hyödyntämismuotoja ja sen lopputuotteita. Konsepti sisältää kasviseinän, joka tuottaa energiaa auringosta käyttämällä kasvimikrobista polttokennotekniikkaa (PMFC). Ajoneuvon lattia osallistuu energian keräämiseen fotosynteesin avulla. Lisäksi sisustus koostuu erilaisista materiaaleista, joiden valmistuksessa käytettiin fotosynteesin lopputuotteita. Sisätilan valonotto on ollut ensisijainen tavoite fotosynteesiä hyödyntävien kasvien ja organismien valon saannin vuoksi. Sisustussuunnittelun muodot ja värit saivat vaikutteita voimakkaasti luonnosta ja kasvien lehdistä.

Avainsanat

Yhteisö auto konsepti

Auton sisusta

Fotosynteesi

Tulevaisuus

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Image 2 Orange migrant *Catopsilia scylla*

Terms

Edges

Edges help define the shape of the models, but they can also be used to transform them. An edge is defined by two vertices at their end points. (Fabian 2017.)

Mesh

A mesh is a collection of vertices, edges, and faces that describe the shape of a 3D object. (A wikibook 2020.)

Polygon

Polygons are straight-sided shapes (3 or more sides), defined by three-dimensional points (vertices) and the straight lines that connect them (edges). (Autodesk 2015.)

UV unwrappin

A UV map is the flat representation of the surface of a 3D model used to easily wrap textures. The process of creating a UV map is called UV unwrapping. (Denham.)

Vertices

A vertex is the smallest component of a polygon model. It is simply a point in a three-dimensional space. By connecting multiple vertices with edges you can create a polygon. (Fabian 2017.)

One
Introduction

01.1 Project content & selection

01.2 Research methods & question

01.3 Graduation work goal

01.1 Project content & selection

Project content

Doing this project was not very straightforward due to problem solving, design decision making, and the elements using photosynthesis. Therefore, arranging the materials was challenging.

In this paper the first topic to be addressed is why the graduation work subject was selected and what were the reasons. After that the world of photosynthesis is explored from how it works to what are the possibilities to use it. After that comes the different research methods that had been used and problems that had to be resolved throughout the concept.

The final chapters show the design process, the sketches, the technical implementation and how the concept was born. The last chapter introduces functions and technical drawings of the final concept.

Topic selection

For me house plants give an escape route from the hectic life that many of us are living these days. To me nature is further away due to big cities and mobility restrictions that we are currently facing.

Plants give a piece of nature to your home. When you are watering them or replanting them, you get to be in touch with something real. It is a nice change to the digital world that we are used to. I find it relaxing to take care of something and see it grow and get stronger due to actions that I make. From these thoughts, I started to build this concept that would combine these two worlds.

Image 3 Australian palants

01.2 Research methods & question

Could cars be self-sufficient? This project researches and shows the possibilities to use future photosynthesis technologies in the vehicle interior design.

Information on photosynthesis was gathered through literature as well as an interview with a professor who has studied the subject. A survey was conducted to receive more information on the traffic habits and preferred ways of transportation of Australian people. A strategic planning technique called SWOT-analysis was also performed to identify the possible strengths and weaknesses of the concept.

Image 4 Australian palants

01.3 Graduation work goal

The goal is to create a futuristic interior concept that uses various methods to harvest energy through photosynthesis for the vehicle. At the same time the concept breaks boundaries and creates different and unique interior design.

The decision to create an interior design concept instead of exterior was based on the possibilities and challenges that came with the interior. Vehicle exterior is already being used to harvest energy from the Sun like in the Sion car from Sono Motors. (Sono Motors) The aim of this concept is to create something new and different from a new perspective.

Image 5 sono-motors-sion-studio-rear (Sono Motors 2021)

Two
The Idea

02.1 Why

02.2 Where

02.3 Community car

02.4 Concept summary

02.1 Why

The idea of a vehicle interior that could use photosynthesis to transform sun light to usable energy popped into my mind at one night surrounded by plants.

What if we could apply the power of photosynthesis into the vehicle and harvest its power to our use. These were the first thoughts that came to be and from those thoughts this concept started to form.

Psychological effect of plants

There are some health benefits of live plants and taking care of them. Taking care of a plants and replanting them is known to lower blood pressure significantly. And there are physiological relaxing effects from flowers and foliage plants. (Lee et al. 2015; Song et al. 2016.)

Recently, several vehicle concepts have emerged that have been used plants in their interior designs, like Volvo Haven project from Oskar Johansson. The reason for this is as simple as it can be, people want to be closer to nature.

Image 6 Girl whit three plants (Candrian 2020)

02.2 Where

The idea of using photosynthesis to collect energy for a vehicle came with restrictions that had to be taken into consideration. Light and the weather conditions were the most important parts and that is why concept is designed for Australia. (Figure 1 & 2) Australian weather conditions are not as restricting as here in Nordic countries. (World Climate Guide a; World Climate Guide b)

Due to these environmental factors users came to be Australian population. Target place became big cities with more users for public transportation and need for more eco-friendly vehicles.

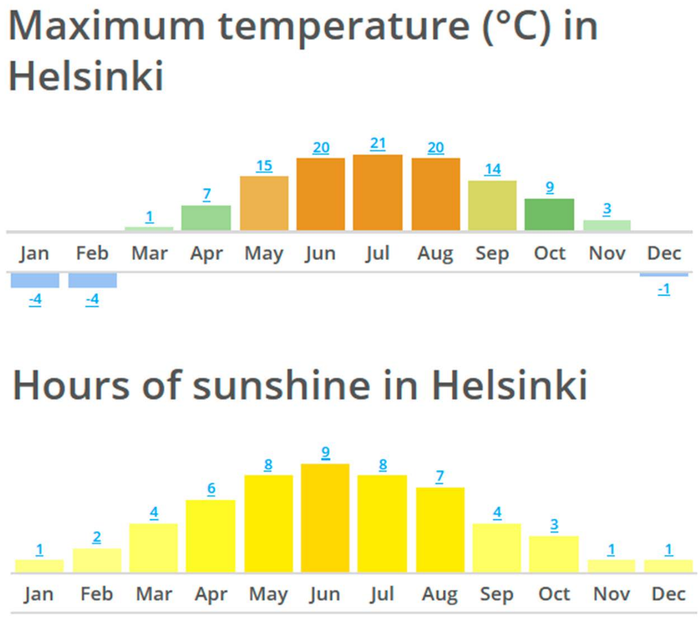


Figure 1 Helsinki climate guide, Finland (World Climate Guide b)

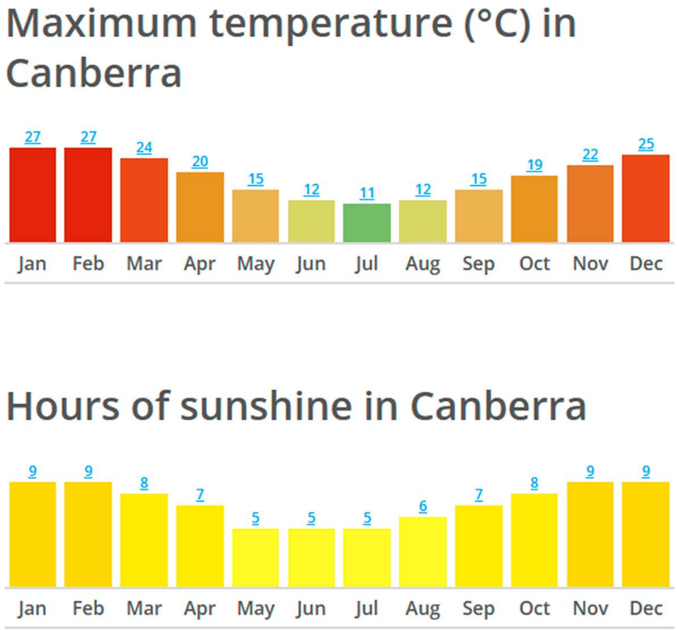


Figure 2 Canberra climate guide, A.C.T. (World Climate Guide a)

02.3 Community car

The decision to make an interior design for a vehicle type other than a normal personal car was based on the environmental friendliness of the product. At the start the idea was to design interior of a taxi. But after research and some conversation with locals, a decision was made to change it to community car or also known as a shared car.

Community cars are a different form of transportation than normal public transport or own personal vehicles. There can be one or multiple vehicles that are used by certain apartment complexes. People who are registered to use these vehicles can book the vehicle for their use and only pay expenses of the journey and additional costs like parking tickets (Travel Somerset).

There are also more public community vehicles that anyone can book or rent through an app whenever the vehicle is free for use. You can even share your own car with your neighbours (Car next door 2021). This makes moving possible for those that do not own their own vehicle or are moving past the times that the public transports are active. It also reduces peoples carbon footprints by renting vehicles from other people and not owning your own.

Image 7 Melbourne VIC, Australia (Whelen 2021)

02.4 Concept summary

- Population density and lack of space
- High vehicle emissions

- Renewable materials produced by photosynthesis
- Moves with electricity

- The carbon footprint is reduced when not everyone needs to have their own vehicle

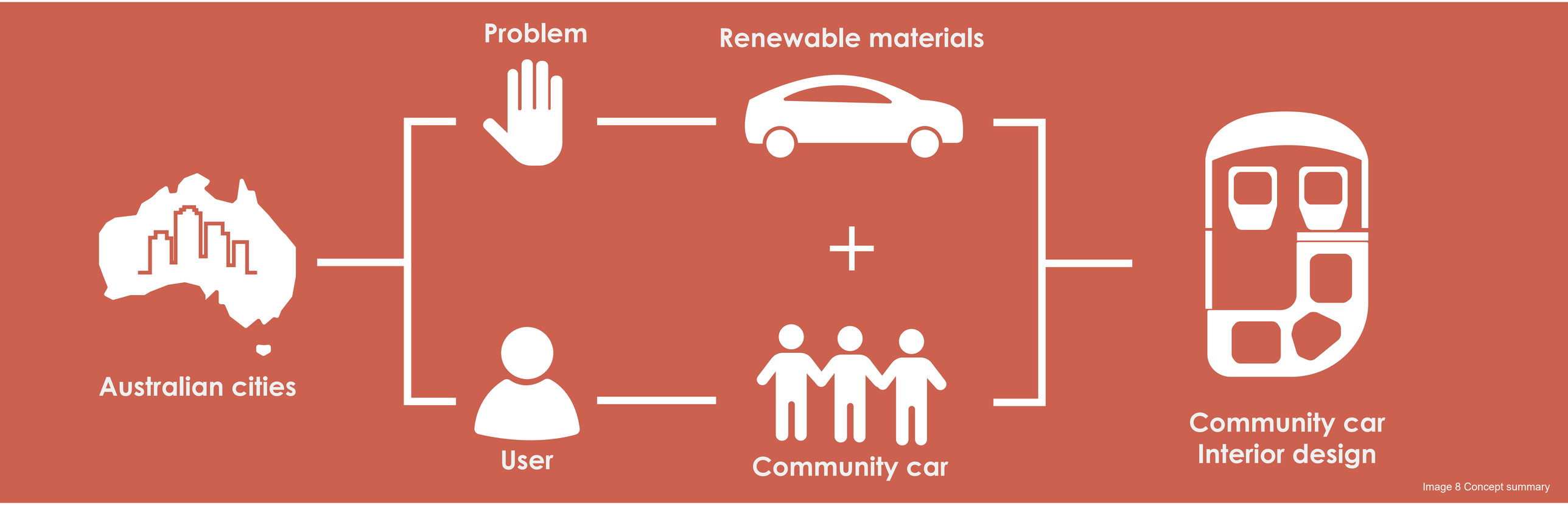


Image 8 Concept summary

- Large Australian cities like Sydney, Melbourne & Brisbane

- Does not own a car
- Needs a car for long distance traveling & late at night, when public transport no longer runs.

- Not just one owner
- More freedom of movement
- Cheaper price for the user

- The user does not have to own his own car and thus avoid extra expenses
- The user can travel more freely and more widely in the city area regardless of public transport schedules and restrictions

Three

Photosynthesis Research

03.1 Photosynthesis in plants

03.2 Use of photosynthesis

03.3 Possibilities

03.4 Artificial photosynthesis

03.5 Research results

03.1 Photosynthesis in plants

How does photosynthesis work and what is it? At its simplest, assimilation, or photosynthesis, is a process in which, among other things, plants and algae combine water (H_2O) and carbon dioxide (CO_2) and form glucose ($C_6H_{12}O_6$) from it. Photosynthesis creates end products like sugars and other organic compounds. All living things that need these compounds exist thanks to photosynthesis. (Kallio 2021.)

Humans are heterotrophs which means that we cannot use direct sun light to our advantage. Humans are completely dependent about photosynthetic organisms like plants, cyanobacteria and green algae that converts sun light to our use. (Kallio 2021.) This process is vital to every living creature on Earth. We need plants to provide us food and most importantly oxygen. Without plants and this process life would not exist here on our planet like we know it (National Geographic).

Plants are autotrophs, that means they produce their own food. They use water, sunlight and carbon dioxide and transforms them using photosynthesis process into oxygen and simple sugars (figure 3). Plants use the sugars as a fuel so that they can live. (National Geographic.)

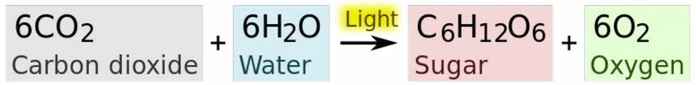


Figure 3 Overall equation for the type of photosynthesis that occurs in plants (ZooFari 2010)

Different wavelengths of light stimulate plants to produce oxygen more effectively than others. Most oxygen production is stimulated by the blue and red light and the least is stimulated by the green light. Plants cannot absorb the green spectrum of light. That is why they appear green to us. (Campbell & Paradise 2016, 4-6.) That is why white leafed plants cannot survive by themselves. They usually need some other plant to be their “host” source of energy. They use them to harvest energy, because they cannot produce it by themselves and are basically parasites to their host plants.

The energy amount that the plant stores can be only estimated because of a difference between plant species and environmental conditions. Plants store much less solar energy than the actual maximum energy efficiency of photosynthesis. Plants cannot absorb all wavelengths of sun light. Only half or less is used and the remainder is reflected or lost to the leaves. Plants only produce as much energy as they need, not more or less. Sometimes when plants needs are exceeded by bright sunlight it leads to formation of excess sugars and starch. Then the plants slow down the photosynthetic process and allows excess sunlight to go unused. (Britannica.)

Image 9 Leaf and the Sun (Spiske 2018)

03.2 Use of photosynthesis

The problem for humanity now is that we are dependent on the end products of photosynthesis formed over millions of years ago, i.e. fossil sources. The problem with fossil fuels also is that they do not regenerate as fast as humanity currently uses them. Instead of using fossil sources we could use photosynthesis to make new renewable resources. (Kallio 2021.)

How can we use photosynthesis to our advantage? Using photosynthetic machinery of a cell that has inherent ability to capture light energy and use that light energy to isolate carbon dioxide from air and form wanted compounds. Photosynthesis research seeks to use pre-existing cells that are genetically modified to make cells work better for our use. Modifying cells to make more efficiently the products they already make and modifying cells to make compounds that they naturally never do in nature. (Kallio 2021.)

A normally living cell is evolutionarily optimized to survive and be able to modify its function under changing conditions to ensure cell survival, division, and proliferation. Inherently, cells are not optimized to efficiently produce a particular compound. Normally, they use the energy they receive for all the functions necessary for cell function and for a wellbeing of a cell (Kallio 2021.)

The cell is designed to use as many resources, energy and building blocks as possible to make the compounds as desired. This is done by modifying cell and removing functions that are not actually necessary for the process, product or for the cell to do well. By dramatically changing the basic functions of the cell, one must be well acquainted with the metabolism of the cell. And consider all the native functions that must not be removed so the cell would not be harmed. In the lab environment it has been shown that photosynthetic cells can be used and can be modified into making different products. (Kallio 2021.)

03.3 Possibilities

There are two possible future ways to use photosynthesis, making biofuel and reusable materials. Currently, there is no way to make fuel efficient enough through photosynthesis directly to build industrial systems where microorganisms, algae or cyanobacteria produce organic compounds and biofuels from carbon dioxide. In the future there can be possibly bigger facilities that have the capacity to produce bigger quantities of fuels to users for their cars. That way the fuel would not come from fossil sources but from photosynthetic processes. (Kallio 2021.)

Image 10 The flame of an oil lamp being refracted through a prismatic film (Thomas 2021)

Image 11 Test tubes in metal rack. (Oxford 2019)

Image 12 Plastic bottle (Mclean 2020)

Another possibility would be making new renewable materials, with photosynthesis end products organic acids like lactate or ethylene that are used these days in plastic productions (Kallio 2021). Ethylene nowadays comes exclusively from nonrenewable petroleum sources (Kallio et al. 2021, 2). Its manufacturing is extremely nature unfriendly and it releases lots of carbon dioxide (Kallio 2021).

Ethylene is used in many different plastics like Polyethylene (PE), Polyethylene chloride (CPE), polyvinyl chloride (PVC) and Polystyrene (PS) (I.C.I.S. 2010). Also, the car industry uses large variation of different kind plastics like Polypropylene (PP), and polyvinyl chloride (PVC). Polyurethane (PU) that is used among other things in foam seating, insulation panels, and cushions in the cars. (EuRIC 2020, 1.)

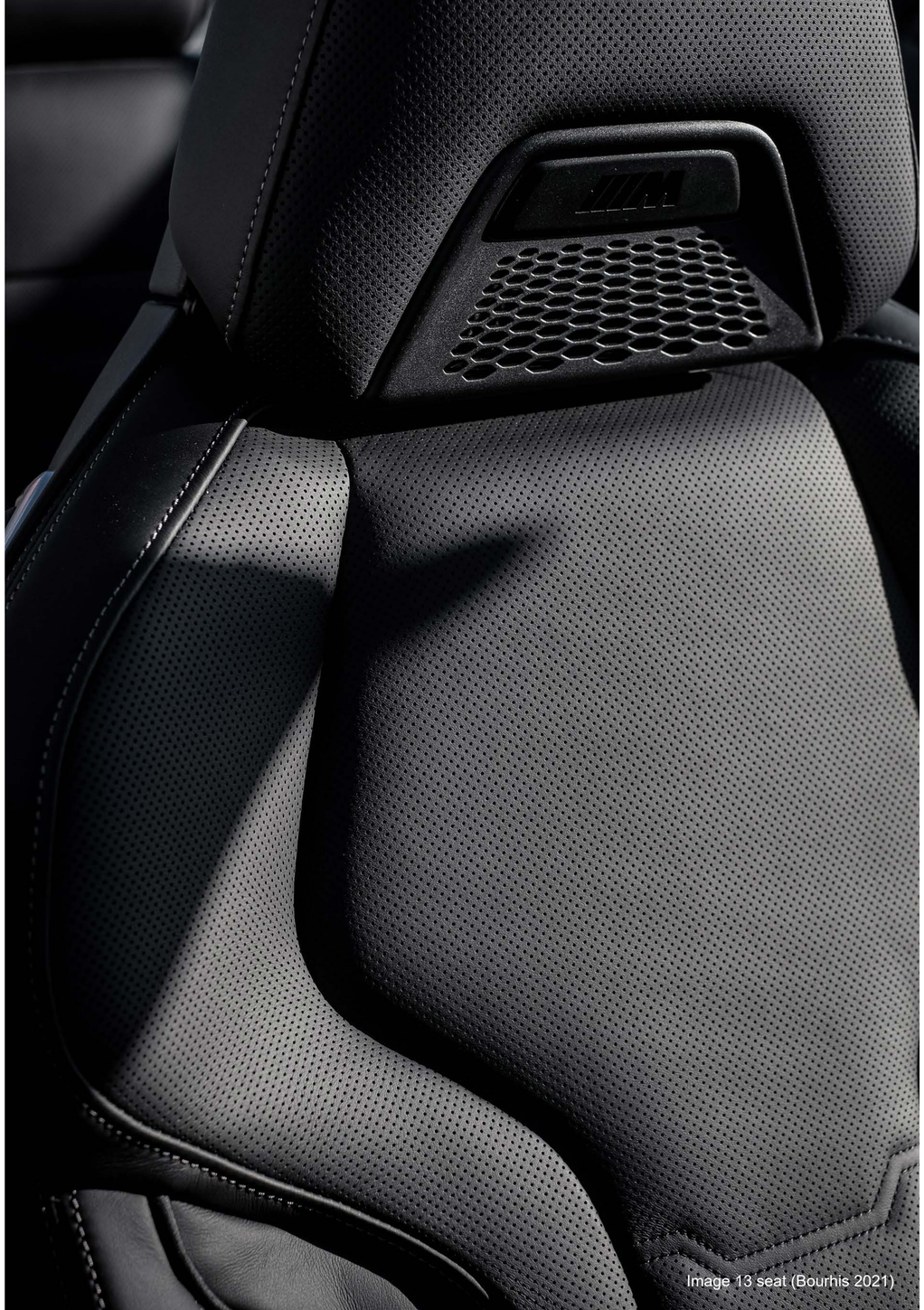


Image 13 seat (Bourhis 2021)

03.4 Artificial photosynthesis

In artificial photosynthesis the basic principle is to convert solar energy but without living cells. Energy from the sun can be converted into several different forms like heat, electricity, and fuels.

In natural photosynthesis in green plants, algae, and cyanobacteria use solar energy to convert carbon dioxide and water to fuel. Artificial photosynthesis is not trying to copy this process but learn from it and reproduce it in smaller man-made system. (Hammerström & Hammer-Schiffer 2009, 1859-1860).

Image 14 Leaf (Bondarenko 2019)

04.5 Research results

The possibility to use photosynthesis to create energy for the vehicle like solar panels is not possible with the technology that we have right now. Due to its large scale, low energy production and complicated methods to transform light energy to electricity, the whole process cannot be scaled small enough to fit in the vehicle. Still, I believe that when this technology is further developed it will be possible to create more efficient energy production in a smaller scale in the future. Cost of the product is likely to increase significantly by these new technologies and it is going to take a while before it reaches the common consumers.

When photosynthesis technologies advanced it is going to be a good alternative source to create renewable materials. Harvesting photosynthesis to our use also would reduce greenhouse gases and at the same time it is another way to harvest solar energy beside solar panels.

Image 15 Australian palants 2

Four

Background Research

04.1 SWOT-analysis

04.2 Australian traffic habits

04.3 Benchmarking

04.4 Moodboard

04.1 SWOT- analysis

The following introduces the strengths, weaknesses, opportunities, and threats of the using materials made with photosynthesis and use photosynthesis for collecting energy in a vehicle interior through SWOT-analysis. The analysis was carried out to map the strengths, weaknesses of the project and force the author to think more deeply about the concept.

Strengths

Renewable materials do not directly contribute to the greenhouse effect because they are part of the bio-based carbon cycle. Unlike fossil raw materials like oil, which is used to make plastic products.

Weaknesses

Why world would change from solar panels to energy made by photosynthetic process. Currently, solar panels are ahead in development and generate more electricity. And new technology is going to cost more.

Opportunity

Using renewable materials and energy sources created by photosynthesis, could reduce greenhouse gases and the using of no renewable fossil sources. Also, in photosynthetic process oxygen is released as a waste product and plants are responsible to providing oxygen in the atmosphere of Earth.

Threats

The biggest threats are the power efficacy of the photosynthesis and how long it is going to take to get at that level that it would be useful for larger consumer group at the right price. And, in certain continents and states the weather conditions are ideal, while in some places the climate limits the efficiency.

04.2 Australian traffic habits

The concept had to be placed in some environment. Australia was selected as the location, which is why the user survey was initiated. Due to the long distance, an online survey was conducted to establish the connection.

A web survey was conducted to know more about the driving culture of Australia, to know what type of vehicles people would normally use the most and how long distances people are traveling and commuting per day. Learning about the taxi and rideshare culture of Australia and how often people would use them helped to decide the direction of the concept. The concept was concentrated into the big cities. That is why the survey was targeted to people who live near or in the Australian big cities like Sydney, Canberra, or Melbourne.

Due to the small number of respondents in the survey, the results of the survey are only indicative. There were 11 respondents to the survey. Answers came from all around the biggest cites of Australia.

Among respondents, the most common form of transportation was by own car due to long distances. The second most common answer was by subway or train. The only rapid transit system metro in Australia is located at Sydney. Cars seem to be the most common of transportation in cities, according to respondents, new rideshare taxi services are highly used as well when you are not capable to drive your own or on the weekends when public transportations are not running as often. Elder demographic seems to use more old-fashioned taxi services than younger people. Commuting times vary widely from place of residence to 10 minutes to an hour. All respondents answered that they did not work during the commute.

An individual discussion was also held with one local to gain a better understanding of the modes of transport used in Australia. Because of the survey and the conversation, the decision was made to change the concepts original direction from a taxi to a community car.

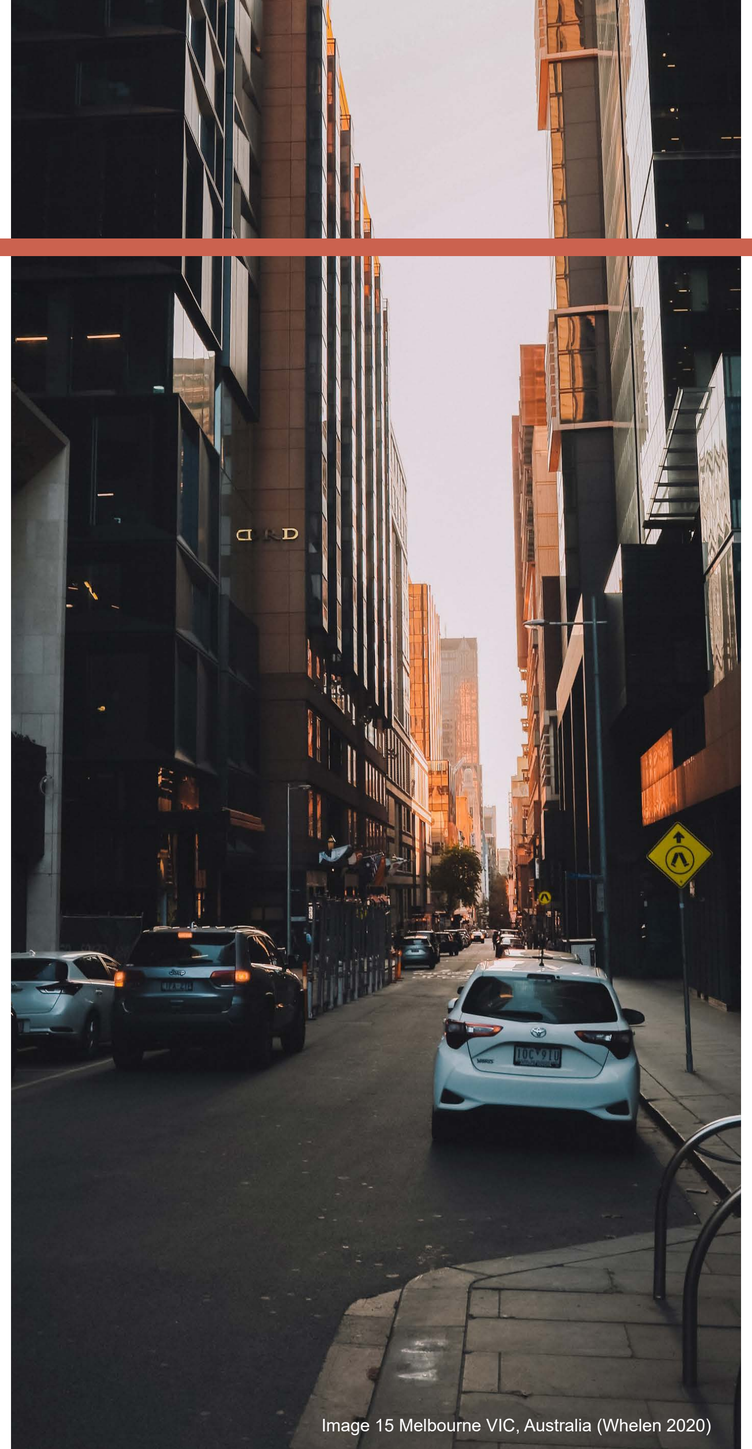


Image 15 Melbourne VIC, Australia (Whelen 2020)

04.3 Benchmarking

Benchmarking 1

Benchmarking as a method is that you compare yourself to others work and you learn from them. Basically, it is a process that happens with learning, comparing, and recognising processes behind the success. (Laaksonen 2019.) This method was introduced because of the mapping of already existing concepts and possibilities to use photosynthesis.

Here are few concepts that were related to the project. The first one is a car that works with solar power by solar panels. There is also Iceland Moss applied to the interior design. (Sono Motors.) That is great way to bring the nature closer and indicate the green properties in the vehicle.

Image 16 Sono Motors Electric car Sion (Sono Motors)

The second concept car is Chines Yez Zoro energy car that uses no gas. It powers itself with photosynthesis by absorbing carbon dioxide from surrounding air and emitting oxygen back into the atmosphere (Hanlon 2010). I am not going to use the actual leaf shapes in the design but use natures generic shapes and use them as a guidance.

The third concept is city car from Hyundai its body consists of transparent solar panels (Motor1 2009). The light green and white is usually connected with the greener and environmentally friendly vehicle concepts. I want to stay away from this colour combination to stand out and break this conception a little.

Image 17 Yez Zero Energy Concept Car (Solaripedia 2010)

Image 18 2020 Hyundai City Car Concept (Motor1 2009)

Benchmarking 2

Here are some concept designs that inspired me. General feeling and aesthetic of these projects pleased my eye.

I liked the light and transparent design of the seats because it created a feeling of space and lightness in the interior.

Image 19 Toyota's I-T-CH Concept 2010 (Porlamfer)

Image 20 Renault Safia - Feeling at home (Porcherot & Lacombe 2018)

Image 21 Volvo Haven (Johansson)

04.4 Moodboard

A moodboard was built to tell the desired atmosphere and appearance of the interior design concept through pictorial means. For the overall feeling of the concept I wanted something clean but colourful to make it more appealing. Having nature as part of the design was the most important thing for me.

As my target customer were Australian people, I chose to include plants and animals known to the area into the design. The Australians unique wildlife and the pride that they feel towards their ecosystem, was the reason I felt that it is important to apply these factors into the design. Some Australian animals and plants were painted and made into prints. They are going to be applied into the materials of the design. The inspiration was taken from colours and shapes of the nature.

Image 22 Moodboard (Gemperle; Shenouda 2019; Singer; Uzun; Zavala;)

Colours & Prints

These colours were picked from Australian nature. I chose warm vibrant yellow and orange for representing nature and the climate of Australia. Dark green was added to bring contrast and represent the plants and leaves of Australian wildlife.

For the print, animals and plants were chosen based on these three colours. These colours were kept all through the concept as a theme colours to bring it together.

Image 23 Print white
Image 24 Print dark Green

Figure 4 Concept colour palette

Five
Design Process

05.1 First sketches
05.2 Idea exploration
05.3 Technical Research
05.4 Technical implementations
05.5 3D modelling

05.1 First sketches

Sketching phase includes doodles and different design options that led to the final design of the concept. The sketching helped get the ideas from my head onto paper.

I started sketching by doing different layout options and seating arrangements. I knew that I wanted to fit five people inside the vehicle to maximize the number of possible users. I wanted to do something a little bit different than normal cars seating arrangements to stand out more. Due to the target country Australia I had to remember that the driver is located on the right side on the car.

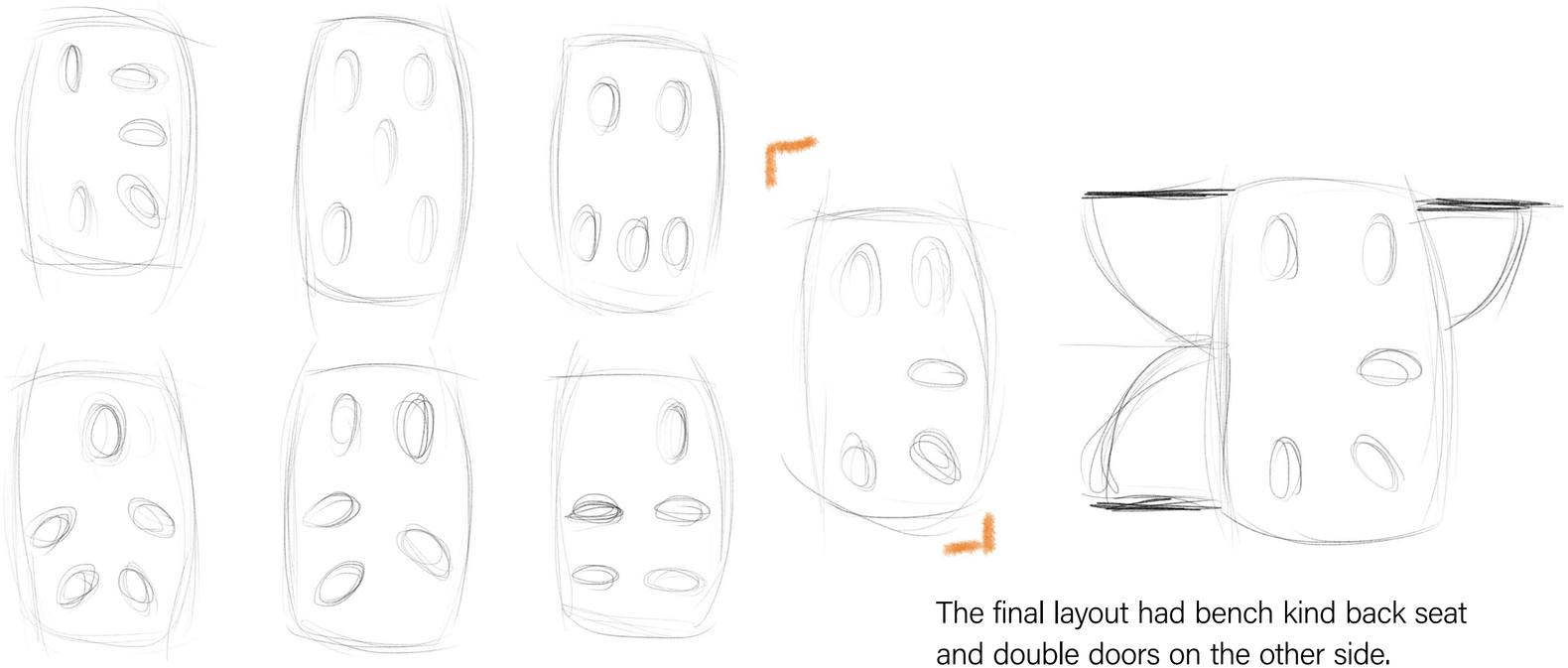


Image 25 Layout option sketches

The final layout had bench kind back seat and double doors on the other side.

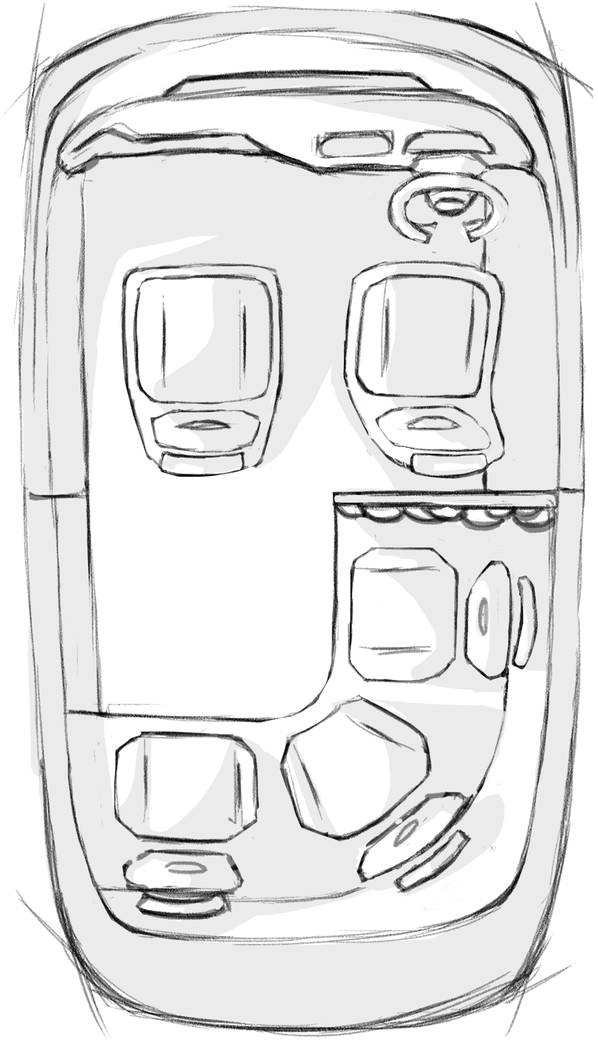


Image 26 Final layout

05.2 Idea exploration

I decided to divide the project into smaller pieces. That helped me to see the project more clearly and not to get overwhelmed by all different components in the interior. I divided the interior in three different categories **seats**, **dashboard**, and **other structures**.

I chose to keep the theme of photosynthesis and plants as a prominent feature of the interior design to connect the photosynthetic aspect to it more clearly. I studied and searched different plant patterns as an inspiration for the seats structure.

I also had to take in consideration the community car side of the project. Good way was making the interior clean and simple so that it would be easier to clean between uses.

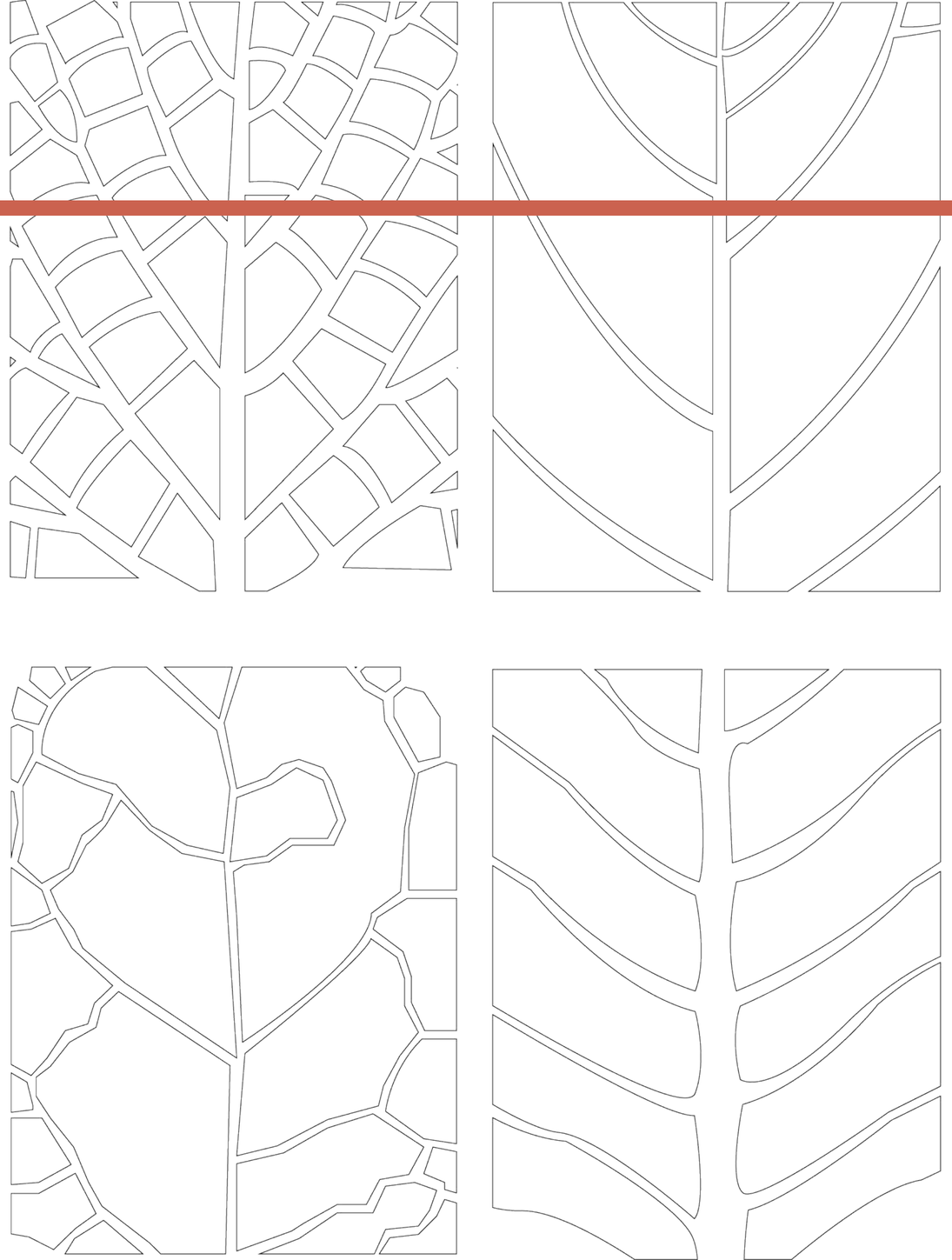


Image 27 Plant patterns

Seats

First, I started to design the front seats. I wanted to give them different appearance than normal car seats. Normally car seats are thick and heavy looking lounge chairs I did not want that for the light intake and the overall feeling of the concept.

I wanted to apply the photosynthetic material in the car floor because it would bring a new way to harvest solar energy. Therefore, I designed the seats to be light and more transparent so the light could shine through and reach as much floor area as possible.

While I was sketching the ideas on the paper, I was not happy with any of them. I had this vision in my mind, but I could not grasp it. First the designs were too masculine and sporty and that was not what I was after. Then I tried different approach I used more soft shapes. From that I created something that was too futuristic and sci-fi for my taste.

Image 28 Seat sketches

After that I took one step backwards and started the process from the basic seat shapes. With this method I finally found what I was after, something that has clean and simple silhouette to better highlight the structure of the seat.

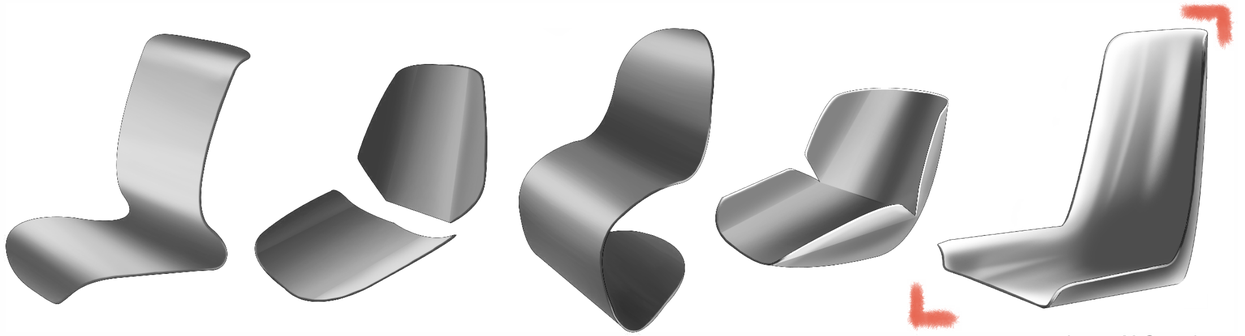


Image 29 Seat shapes

Image 30 Seat render

For the back seats I continued the same style. I tried different seating arrangements, but I ended up in separate seats because of the light distribution. If the seats would be together the whole structure and design of the bench frame would not show.

And the whole backseat would look more massive and heavier than intended. I chose to leave the seat cushions reduced to give the design contrast between the seats and the frames.

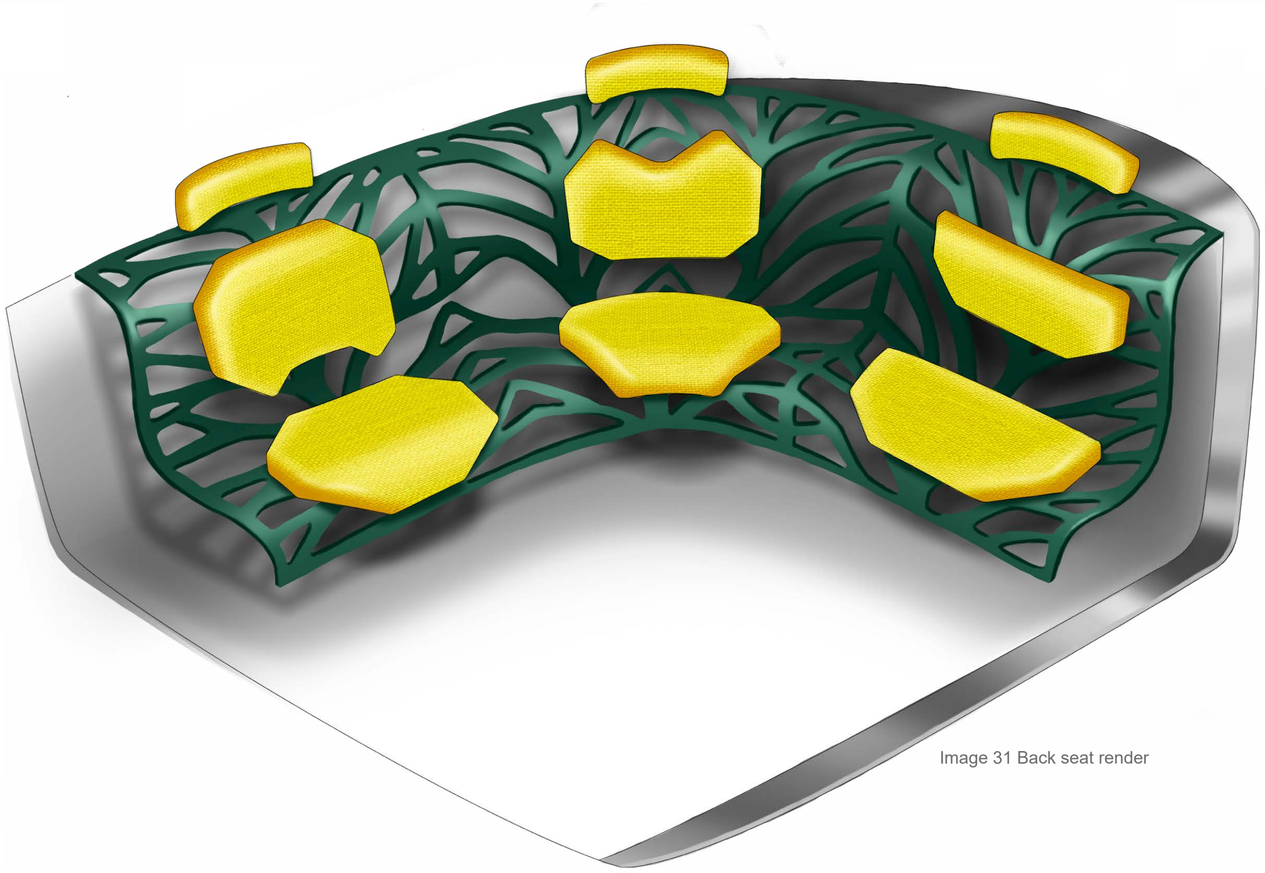


Image 31 Back seat render

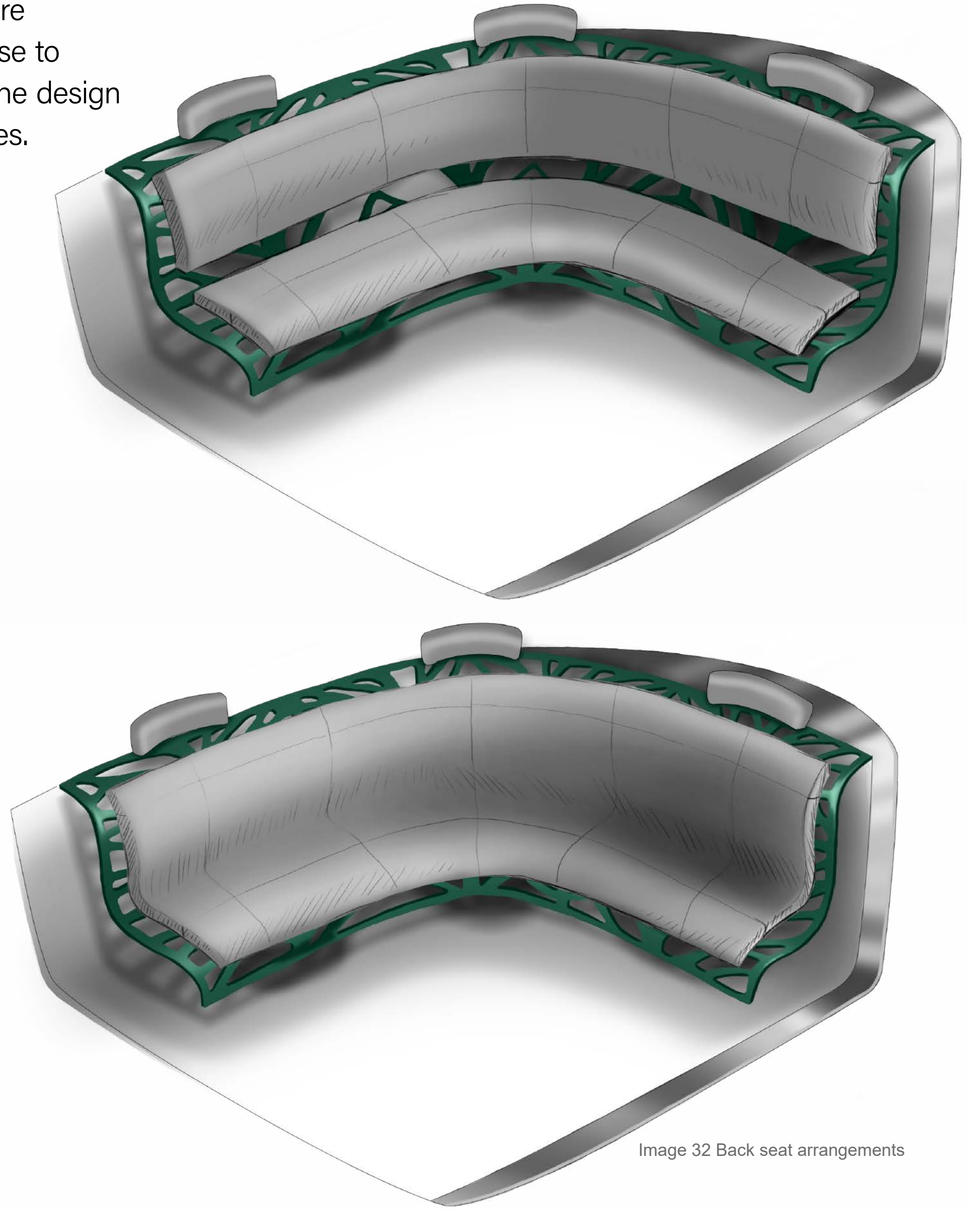


Image 32 Back seat arrangements

Dashboard

The dashboard I desired to give more clean and simpler look, because the other elements for example the seats have an organic and more hectic appearance. I did not want to overwhelm the users with messy and too busy interior.

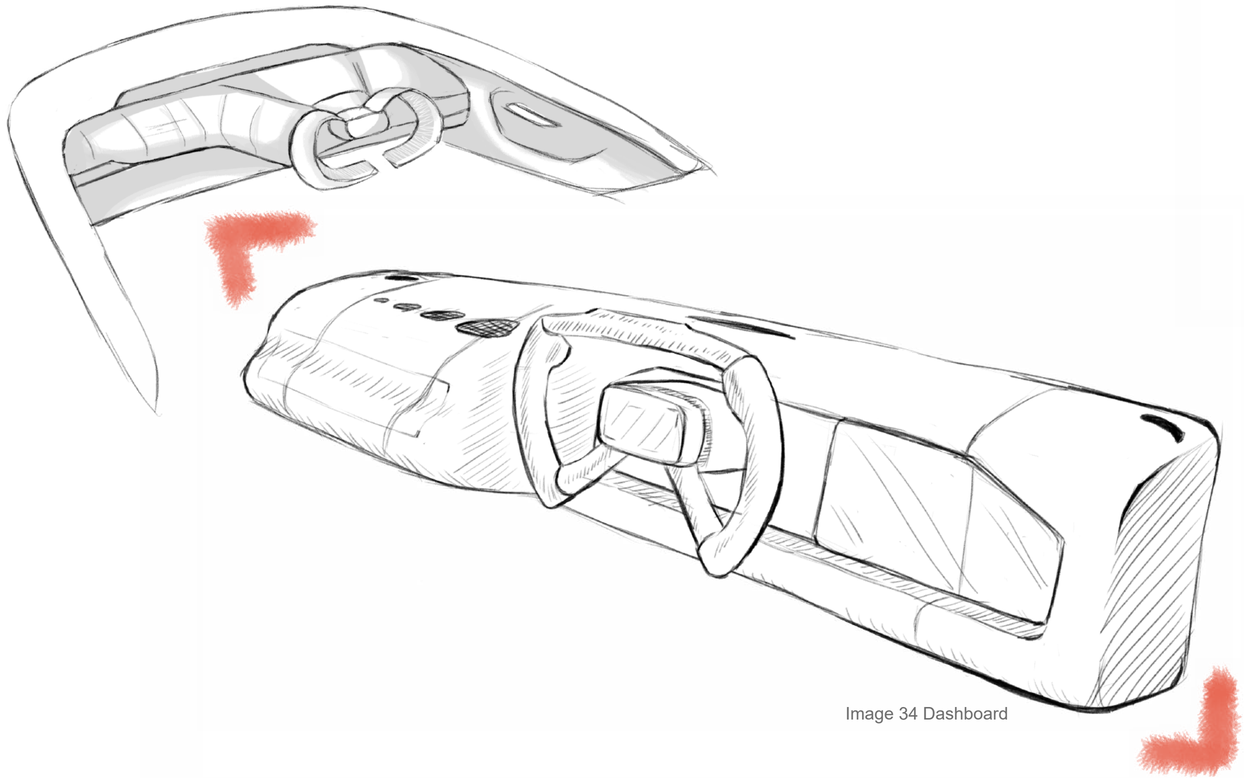


Image 34 Dashboard

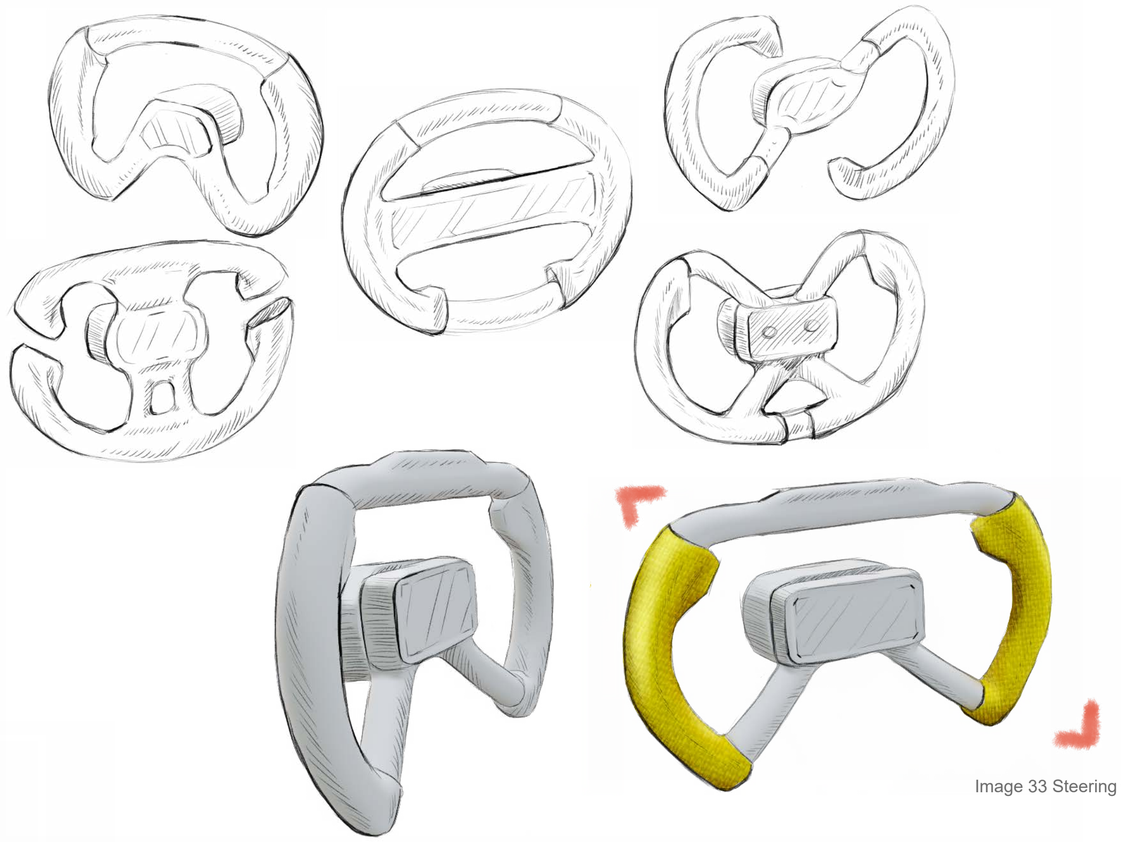


Image 33 Steering wheel

For the steering wheel I knew that I did not want it to be just round because it had to have same feeling that rest of the interior. Also, it could not be any wild shape it had to be user friendly, easy to handle, and drive.

Other structures

Plant wall

First design for the plant wall was literal just a wall. Luckily, I talked to my teacher, **Lee Walton**, who pointed this out. The first design did not fit into the rest of the concept due its massiveness and the fact that it was blocking the sun light. Something had to be done.

The direction of the branch was the main design point. The intention was to find a good balance between the branches and the plant pots. A couple of sketches had too many small branches and by making the design reduced and cleaner the desired result was achieved.

Plant wall uses Green Sparks PMFCs technology that collects solar energy. The Sun light is transferred to electricity by bacteria that are in the soil. First the plant wall was merely a decorative aspect in the product. With this technology the wall has actual purpose in the concept.

Image 35 Plant wall

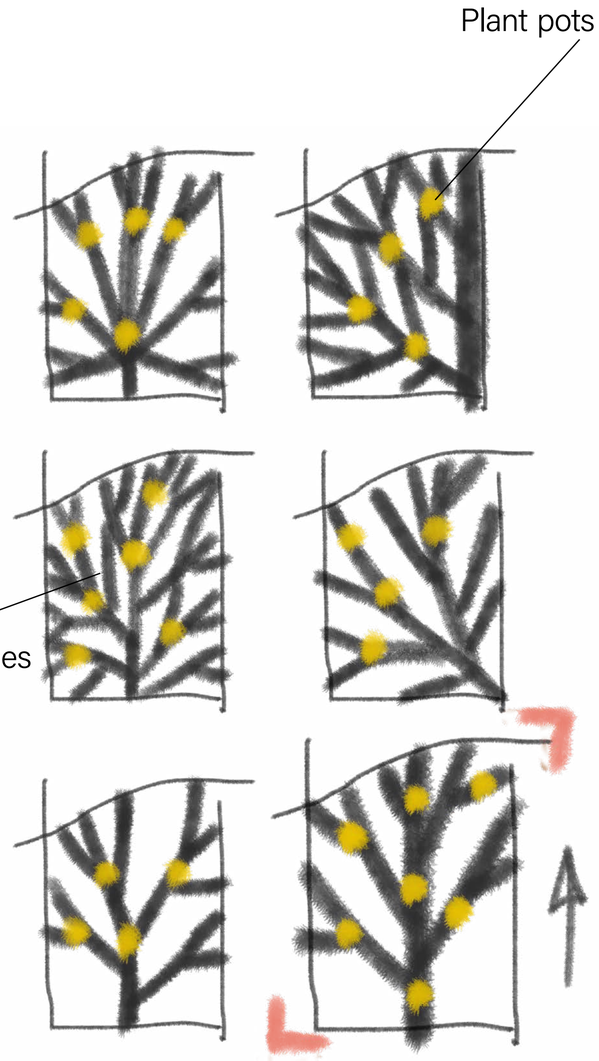
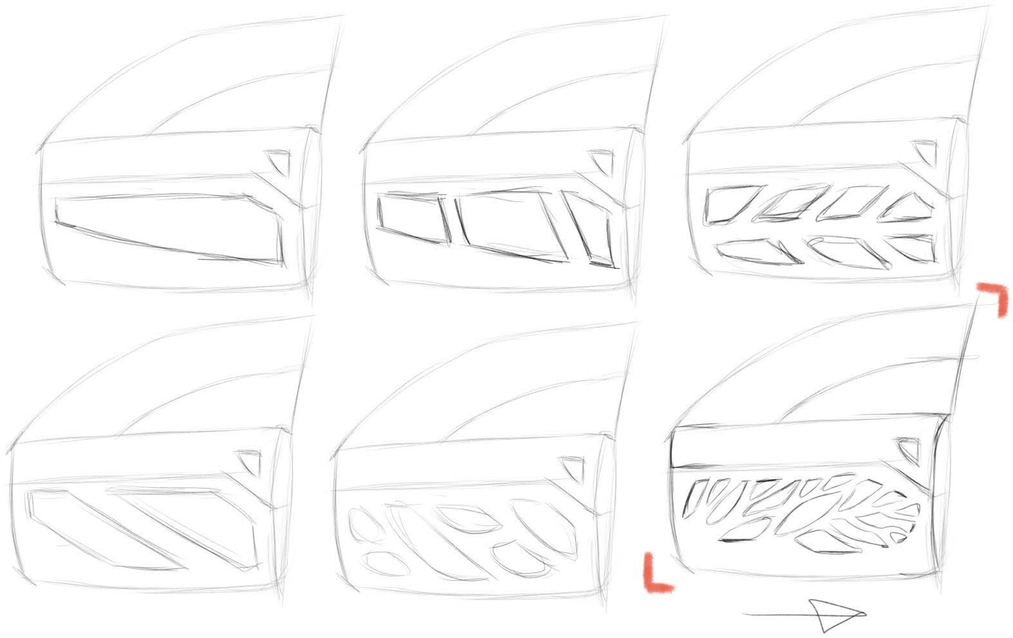


Image 36 Plant wall sketches

Door

The last design decision was to add some see through elements to the doors. I had a vision for see through doors at the start of this process, but I could not wrap my head around them.

The design of the doors had to fit into the rest of the concept and intention was to bring some interesting light effects inside of the vehicle and same time create warm ambiance. I wanted the windows to be still openable for practicality and user friendliness.



"Branch growing" direction

Image 37 Door sketches

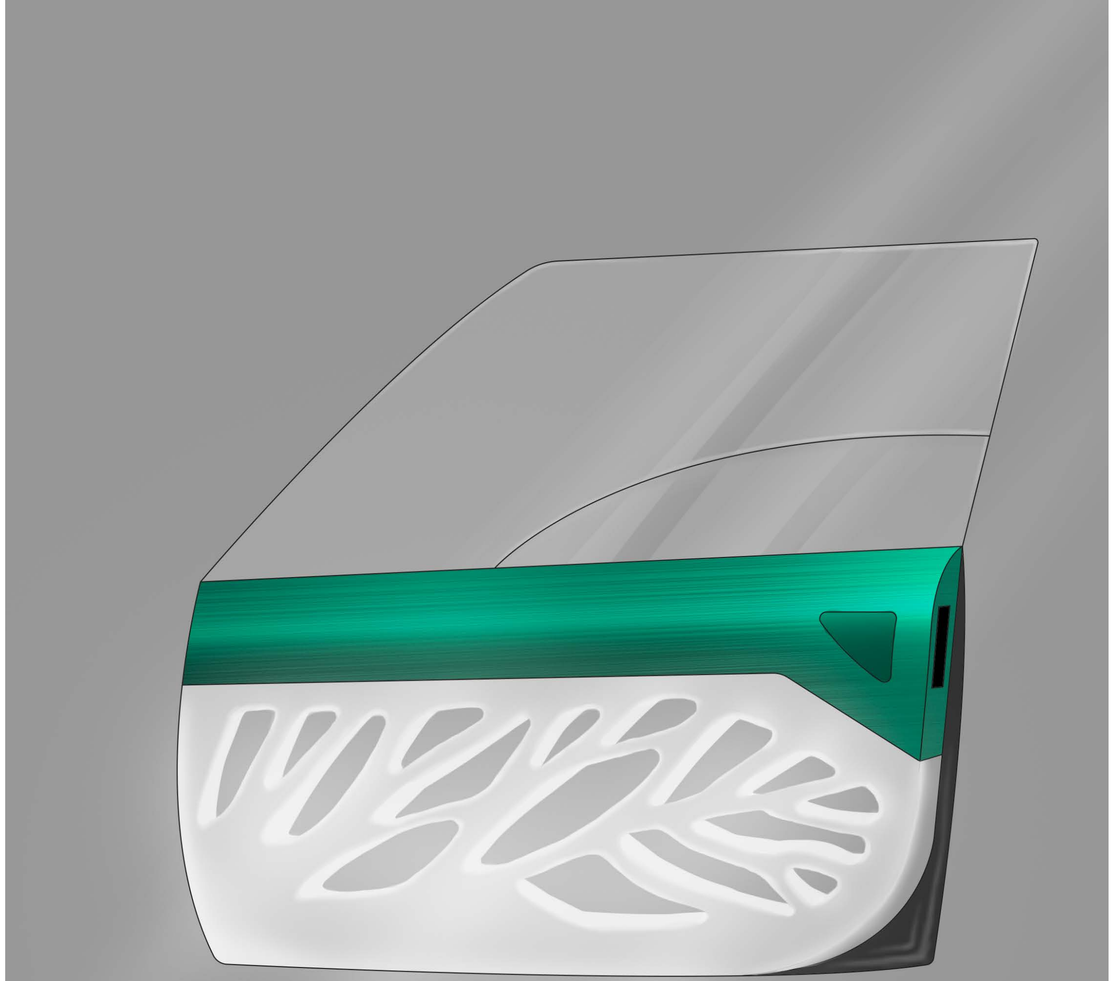


Image 38 Door render

05.3 Technological research

Heating problem

The issue was overheating the interior of the vehicle, due to maximized light intake for the electricity production. A solution had to be found, for the sake of plants and users, also trying to cool the vehicle would be a waste of energy. The search for different solutions began to solve this problem.

The goal was to find a material that would prevent light heat radiation from entering the car interior. After searching the solution, Low-E glass (low thermal emissivity glass) which not only reflects heat away during the day but keeps the heat inside the vehicle even at cold nights stood out. It is usually used in house windows. A film coating is applied to the raw glass in the manufacturing stage. Instead of letting the heat come through it reflects radiant infrared energy back towards the Sun. (Glass rite 2012a.)

One issue popped into my head, that how plants are going to be affected by this technology. Most Low-E glass transmits 59% to 75% of visible light, and compared to normal glass that transmits about 81%, so it does not drastically affect the day light intake. It also allows plants to have their desired wavelengths of light for good growth. Low-E glass also blocks ultraviolet radiation that can be harmful for plants in large amounts. (Glass rite 2012b.)

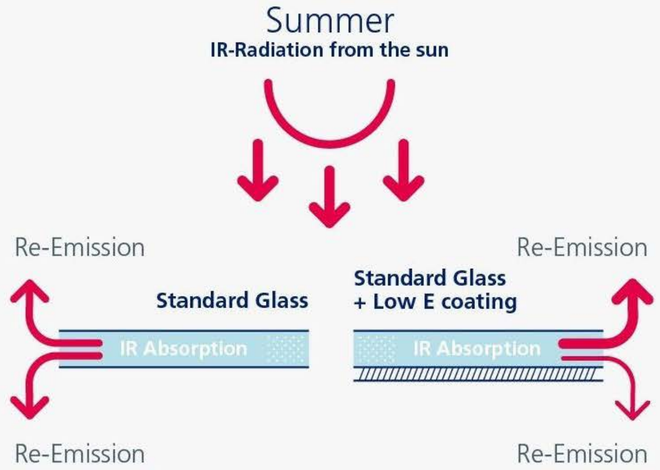


Image 39 Tech info low-e summer (AGC Automotive)

Green Spark Technology

Research project Green Spark created by Elana Mitro uses plants to produce renewable energy. The key matter in this project was to use plants to convert light energy, carbon dioxide and water into organic compounds and give those compounds to the symbiotic bacterium that lives in the soil of the plants. There bacteria can break down the matter and produce electricity. This technology is called plant-microbial fuel cells, PMFCs. (Sovereign Nature Initiative.)

In their final installation they connected 68 ceramic pots together. The installation was capable of charging 2 smartphones simultaneously and each of the pots was capable to produce up to 0,7 Volts. (Sovereign Nature Initiative.)

By using this technique in a plant wall, it provides not only a calming and decorative benefit, but also the opportunity to collect solar energy in a new way. In this way, we can also exploit the full potential of plants.

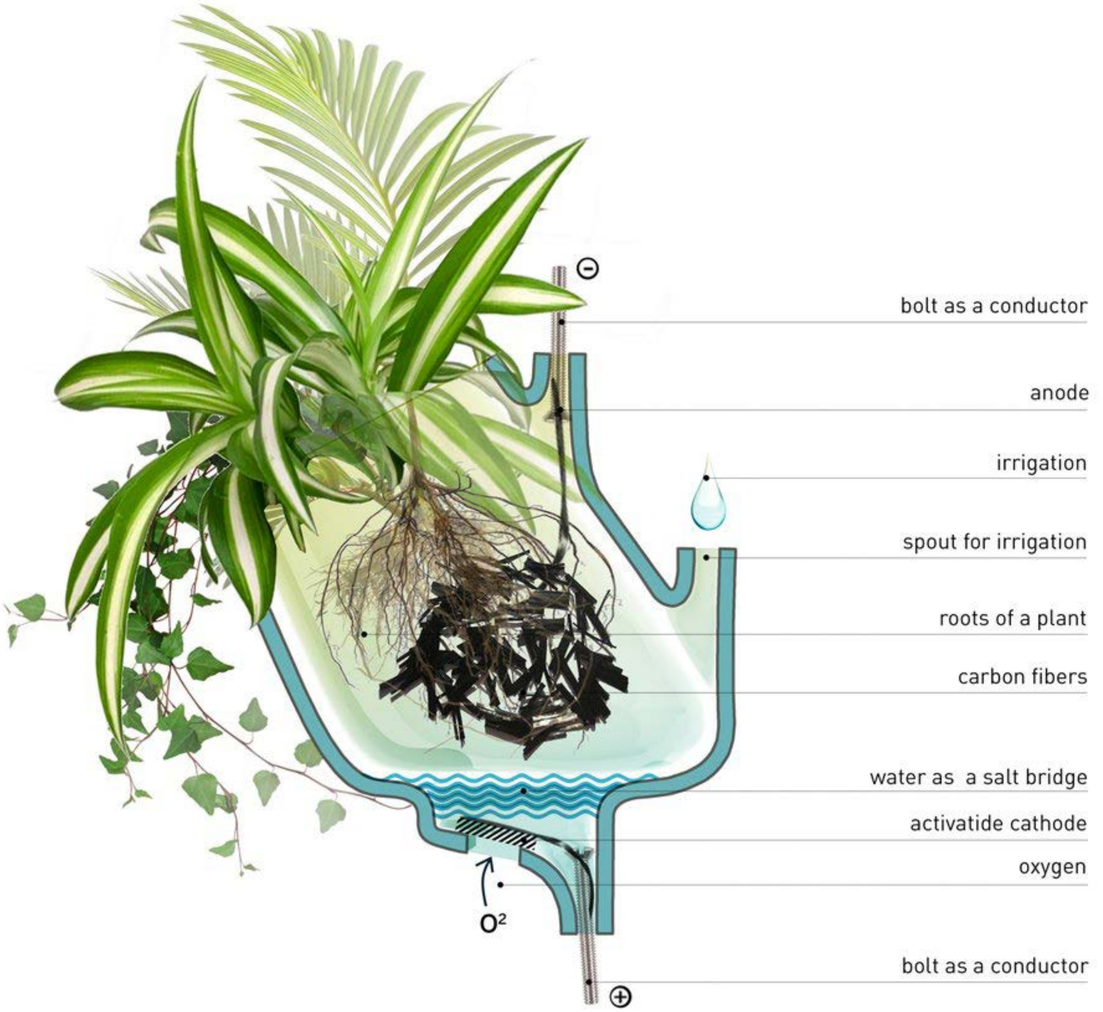


Image 40 Pot concept structure (Sovereign Nature Initiative)

05.3 Technical implementations

Different techniques and implementations were chosen in the interior design. After getting to know the different possibilities to use photosynthesis and its end products the following ways were chosen.

Materials

Using different kind plastics that contains for example ethylene. By replacing the ethylene that came from crude oil into an ethylene that was made by photosynthesis we could have more renewable materials. These future materials are used to make interior concept environment friendly.

PMFCs

Green Sparks plant-microbial fuel cells, PMFCs, technology is going to be applied into the interiors plant wall. And by doing this the car is made more self-sufficient. Plants are going to transform energy from the sun and with assistance from the bacteria in the soil to transform it into electricity and thus charging the car.

Photosynthetic material

I chose to apply the possibility of using photosynthetic organisms for harvesting energy into the design believing it would be an interesting development in technology. Currently, we may not have the potential resources and knowledge to build an energy collector that would use photosynthesis to collect energy from the sun and convert it into electricity. But I believe that at some point in the future it might be possible to make the process so compact and efficient that it could be used in this way.

Low-E glass

To solve indoor heating problem the Low-E glass was implemented into the design. Low-E glass has a film coating that reflects radiant infrared energy. Its main ability is to keep the energy outside and still let the visible light come through. That way the heat stays outside through the day and the vehicle stays warmer through night. (Glass rite 2012a.) Making it perfect for the plants inside.

05.4 3D modelling

In the concept I used 3D modelling with Blender to help me design and finalise the interior concept. I wanted to learn 3D modelling. I previously used few 3D modelling programs in school but none of them stuck in my head. The school went through many different modeling programs just scratching the surface of them which caused confusion between the different programs and the state that I did not actually know any of them. They always seemed too strict and measurement oriented. Because nature of my concept organic forms I needed to use more flexible modeling program.

Interior model was done with Blender. It was chosen because it was free and there is plenty of different kind of tutorials in the internet. My Blender journey started by watching basic tutorials and get myself familiar with the program. After I was confident enough, I started do the interior model.

I did not know how and where to start so decided to do the seats first again. With the organic shapes of the seats, I wanted to know if there would be easier way to do them than just modeling them piece by piece.

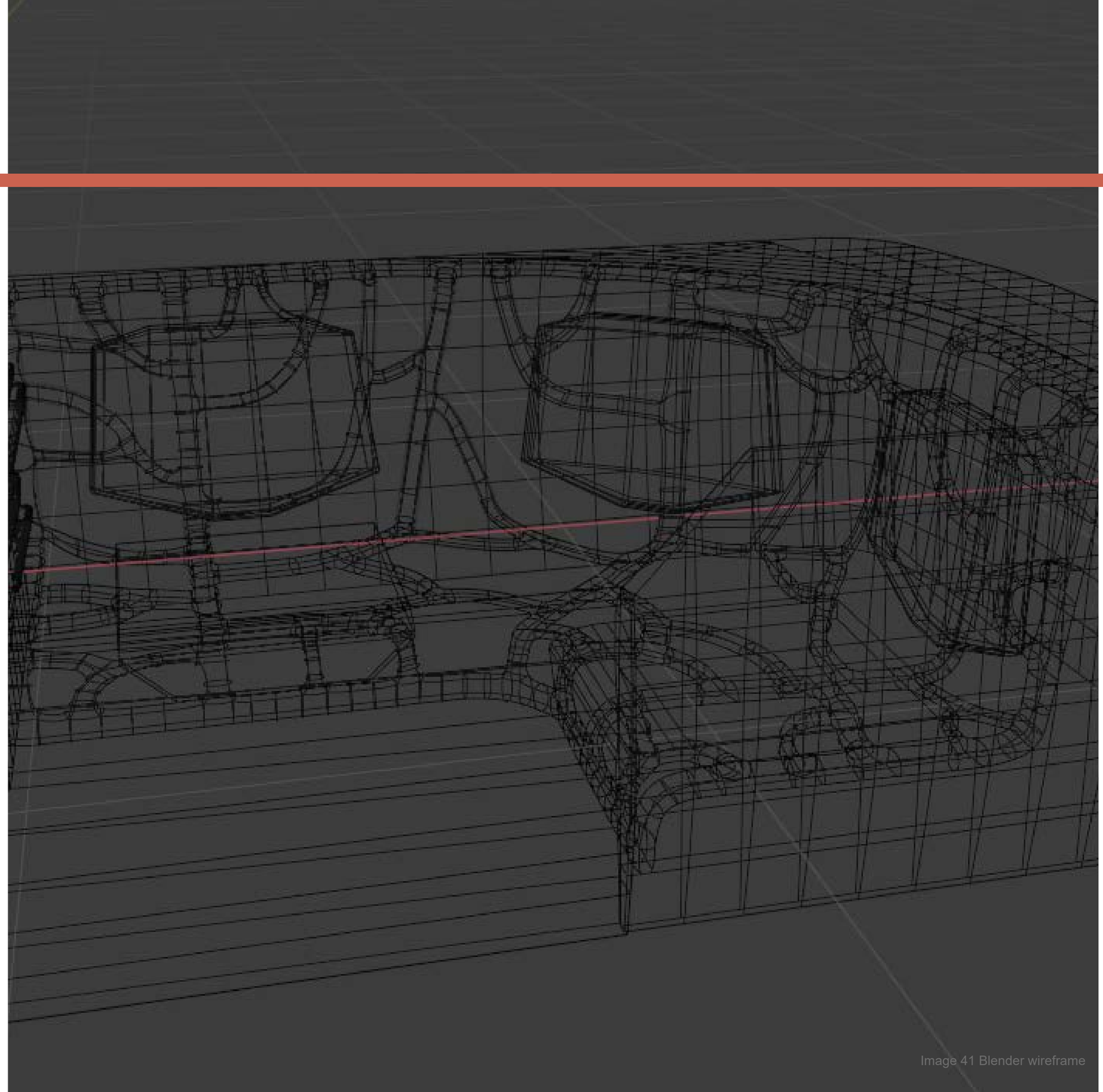
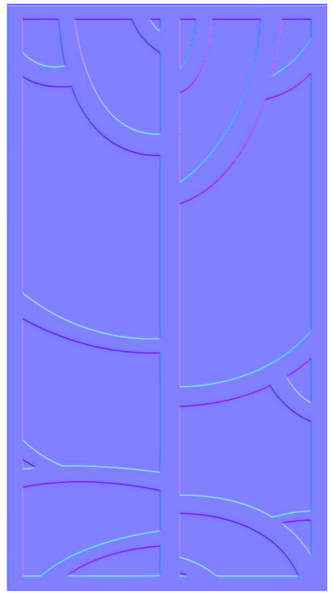


Image 41 Blender wireframe

First, I made the seats basic structure and tried to apply the holes into the seat with the texture map. I did an experimental pattern for the seat with Adobe Illustrator and tried if the texture mapping would work easily (Image 42). The hardest and the most complicated part was the UV unwrapping (Image 43). Seat had to be UV mapped so I could put the texture on it the right way. After watching couple tutorials and getting the settings correctly I was able to get the texture map on the seat and make the desirable holes in it. Only problem at this point was that the seat did not have a thickness. I tried to add it with solidify modifier but that did not bring the wanted even thickness.

Last I made the normal map for the texture and tried to get the thickness occur with it (Image 42). Model still appeared flat. I did not get the result that I wanted, and I did not want to waste any more time, so I decided to model them for real.

Normal map



Seat pattern

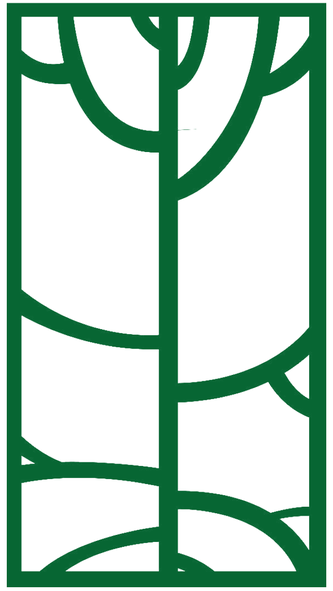
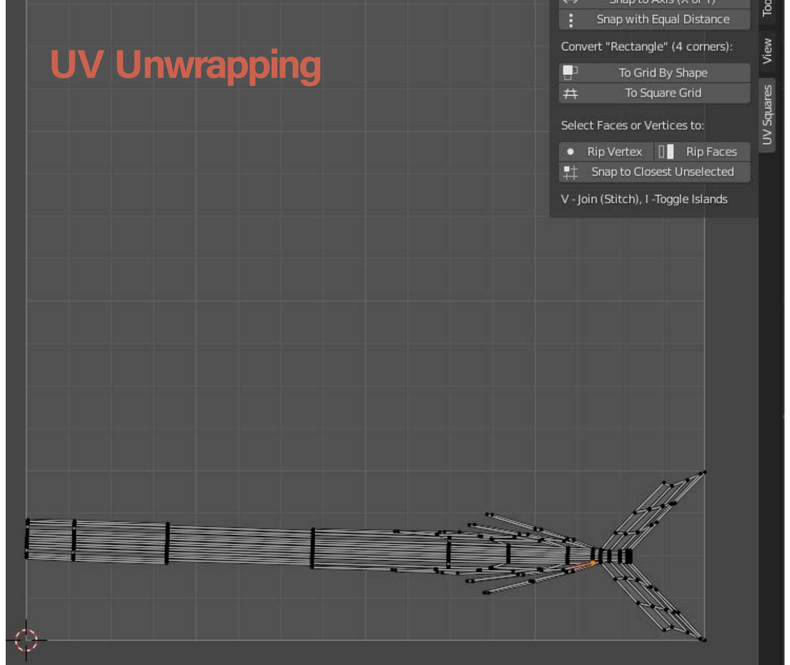


Image 42 Normal map & Seat pattern



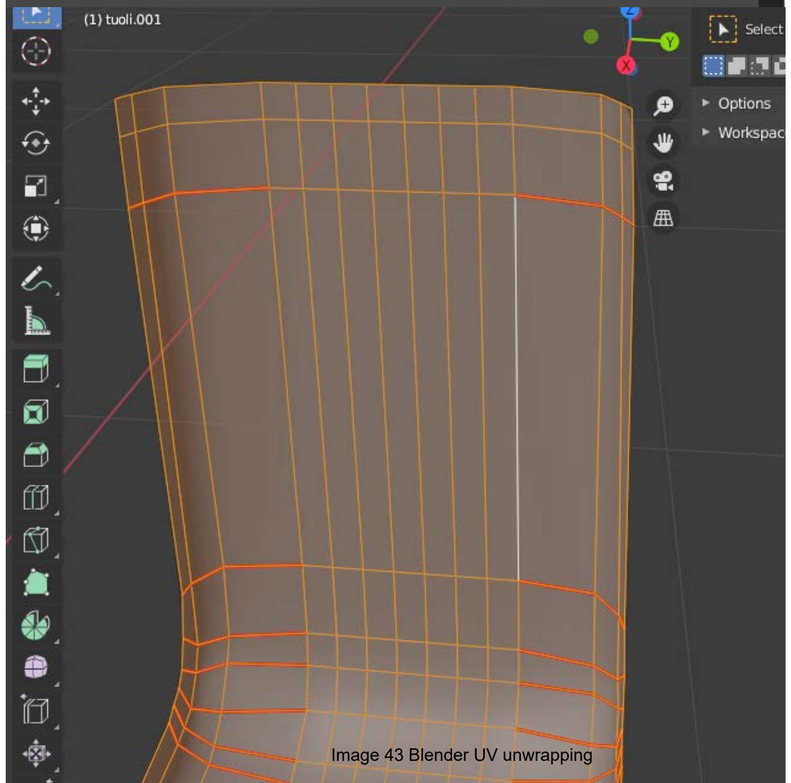


Image 43 Blender UV unwrapping

It was little bit laborious but for my surprise it did not take as much time that I expected. I decided to do the work with the methods that I already knew and not waste my time to try to do things in a different way.

While making other structures I came across with the issue of face orientation of the objects. When combining two objects together they did not fuse together seamlessly. After that mistake I decided to model the objects in that way that I could see the face orientation (Image 44). That helped me to see immediately what the right side of the model was.

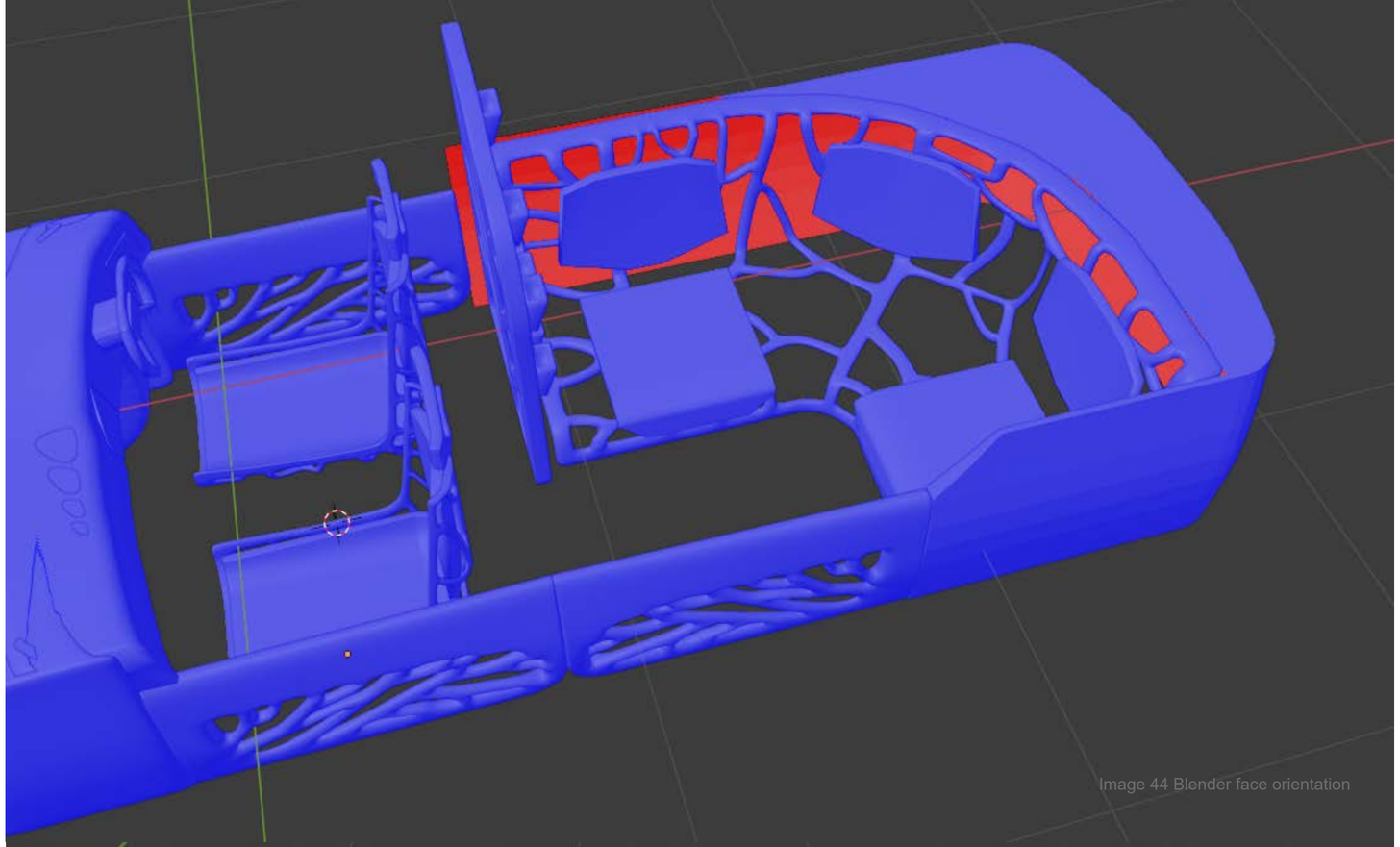


Image 44 Blender face orientation

Image 45 Blender back seat

Image 46 Blender front seat

While applying the material to the 3D model for the final renders I came across with a difficulty. For the materials to be added to the 3D model, the models first needed to UV unwrapped. When I did the seat part of the bench, I had created a model with too many vertices and edges which made the mesh of the model messy (Image 47). Because of this, the model was difficult to UV unwrap and the material was distorted (Image 48). In the future, I will try to make models with as few polygons as possible to avoid this problem.

I wanted to explore all my ideas and the best way was to use Blender. 3D modelling helped me see the details and flaws in the design that I otherwise would not have noticed or overlooked. Also, it was easier to see the design elements in correct sizes, move them around and make changes if needed. Choosing Blender was the right decision for my concept design. The time and effort I put into learning to use 3D modelling software was not in vain. Versatility and simple tools of Blender got me into the world of 3D modeling. With other modeling programs, I would hardly have achieved the desired result.

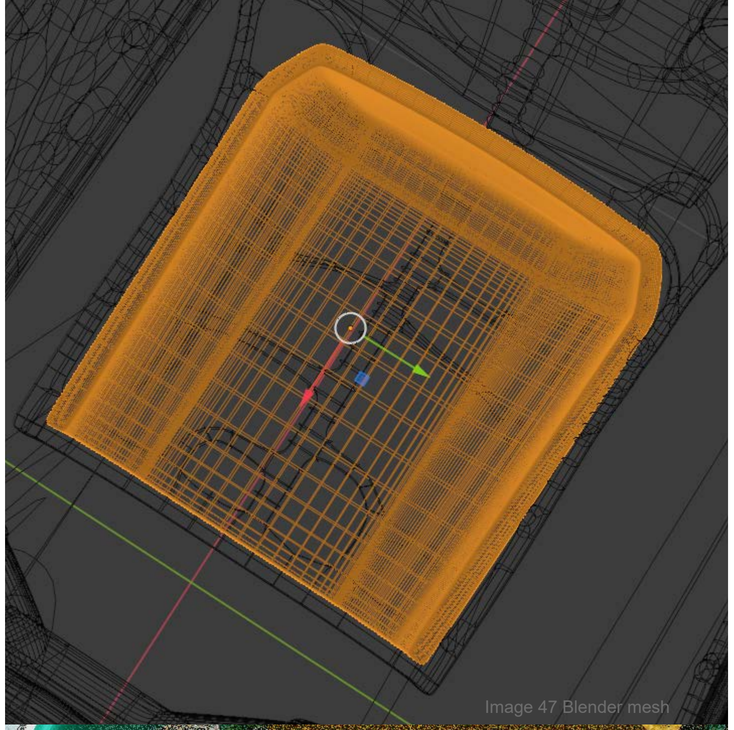


Image 47 Blender mesh

Image 48 Material applied to the mesh

Image 49 Blender render 1

Plants: (CGTrader)
Materials: (CC0 Textures)

Image 50 Blender render 2

Plants: (CGTrader)
Materials: (CC0 Textures)

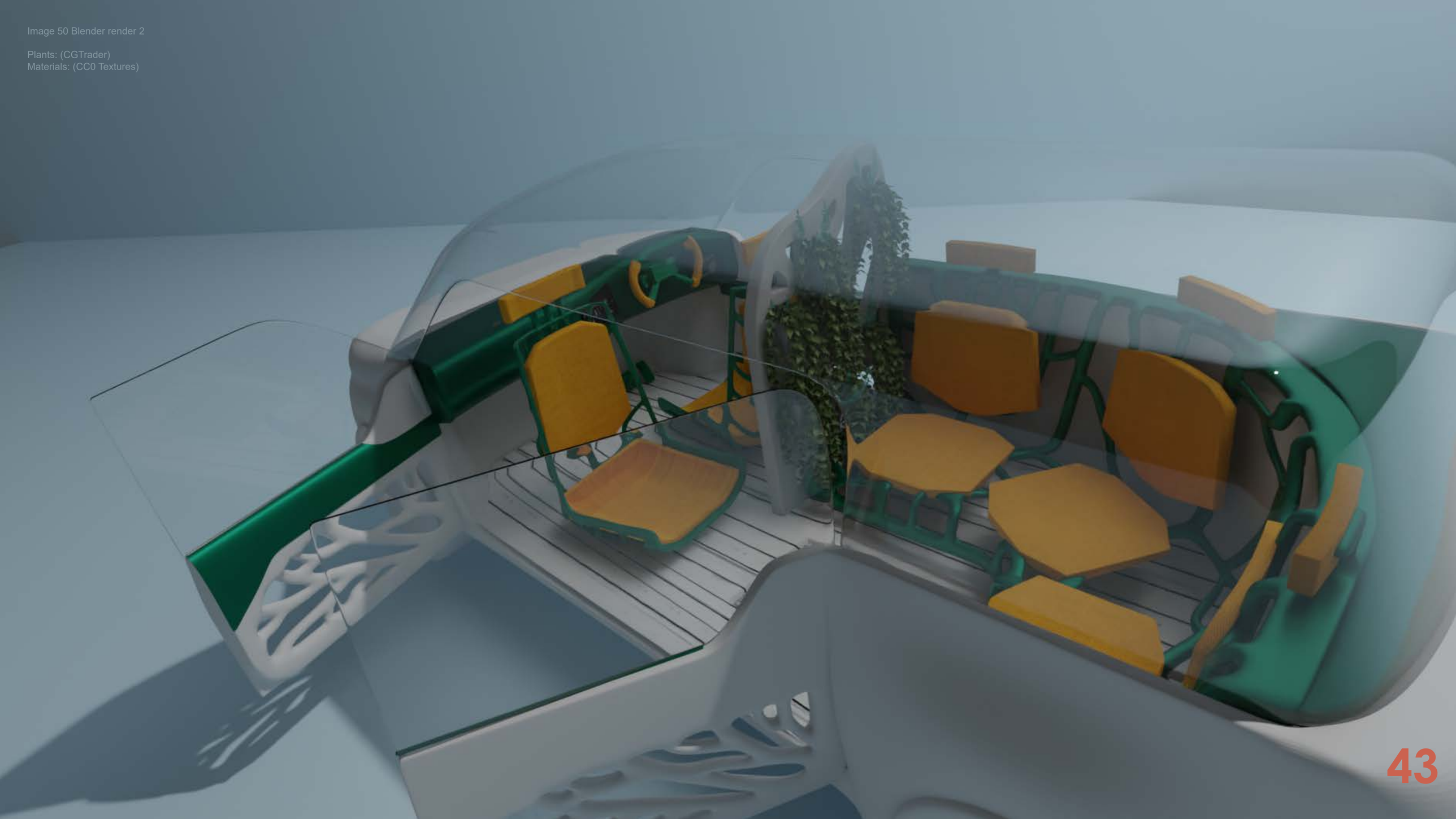


Image 51 Blender render 3

Plants: (CGTrader)
Materials: (CC0 Textures)

Image 52 Blender render 4

Plants: (CGTrader)
Materials: (CC0 Textures)

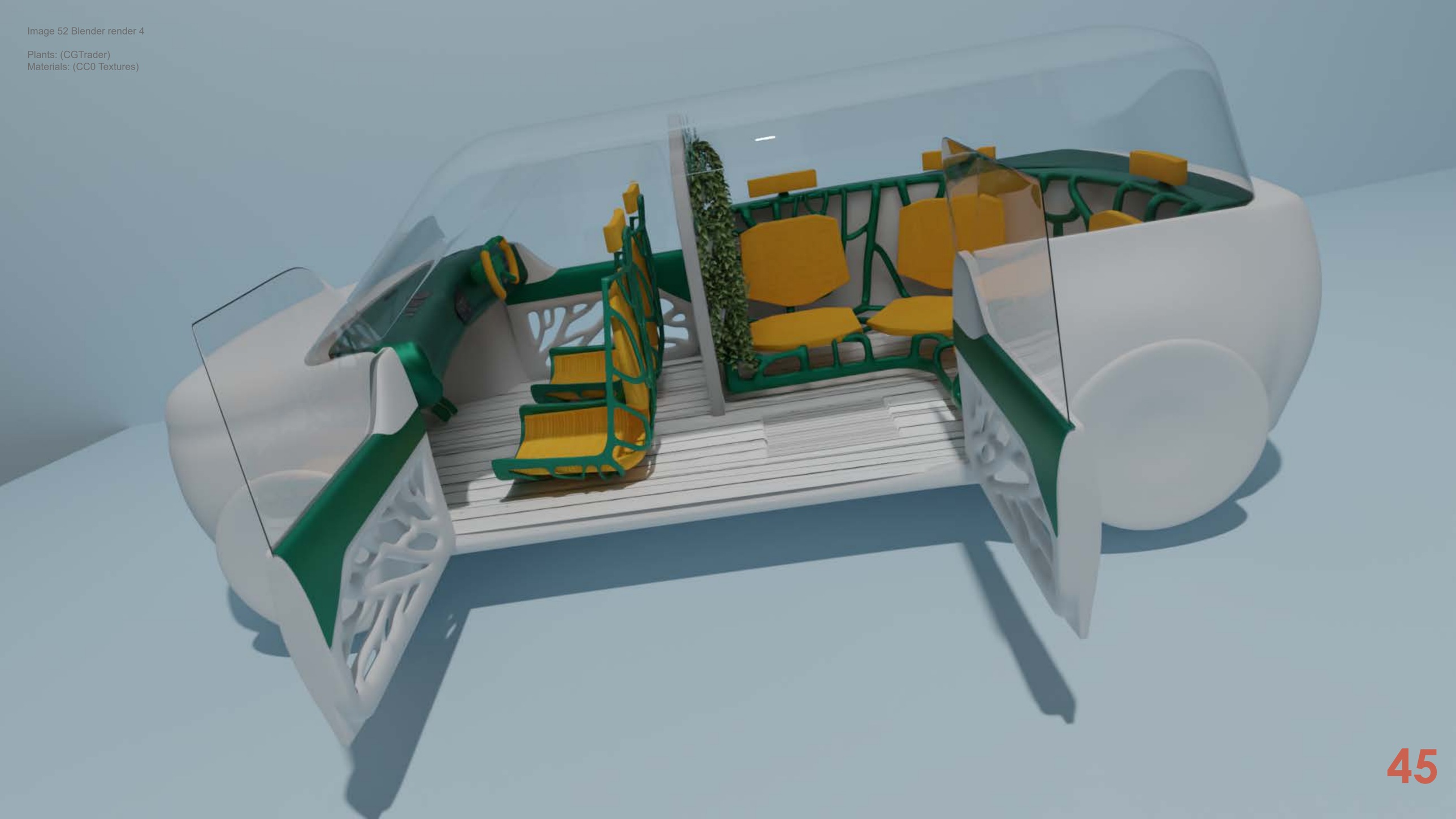


Image 53 Blender render 5

Plants: (CGTrader)
Materials: (CC0 Textures)

Six
Final Concept

06.1 Concept presentation
06.2 Function

06.1 Concept presentation

The final concept is presented here. This section includes explanation pictures of the function and technical drawings.

Community car interior design concept is designed for the biggest cities of Australia. The concept includes two different techniques for collecting solar energy with photosynthesis and the end products of photosynthesis have also been utilized in materials. With these implementations the vehicle is more environmentally friendly and self-sufficient. The vehicle transforms from a normal interior into a small working space. By making the vehicle versatile, it serves as a commuting vehicle and at the same time a mobile work environment.

Image 54 Indoor render

Exploded view

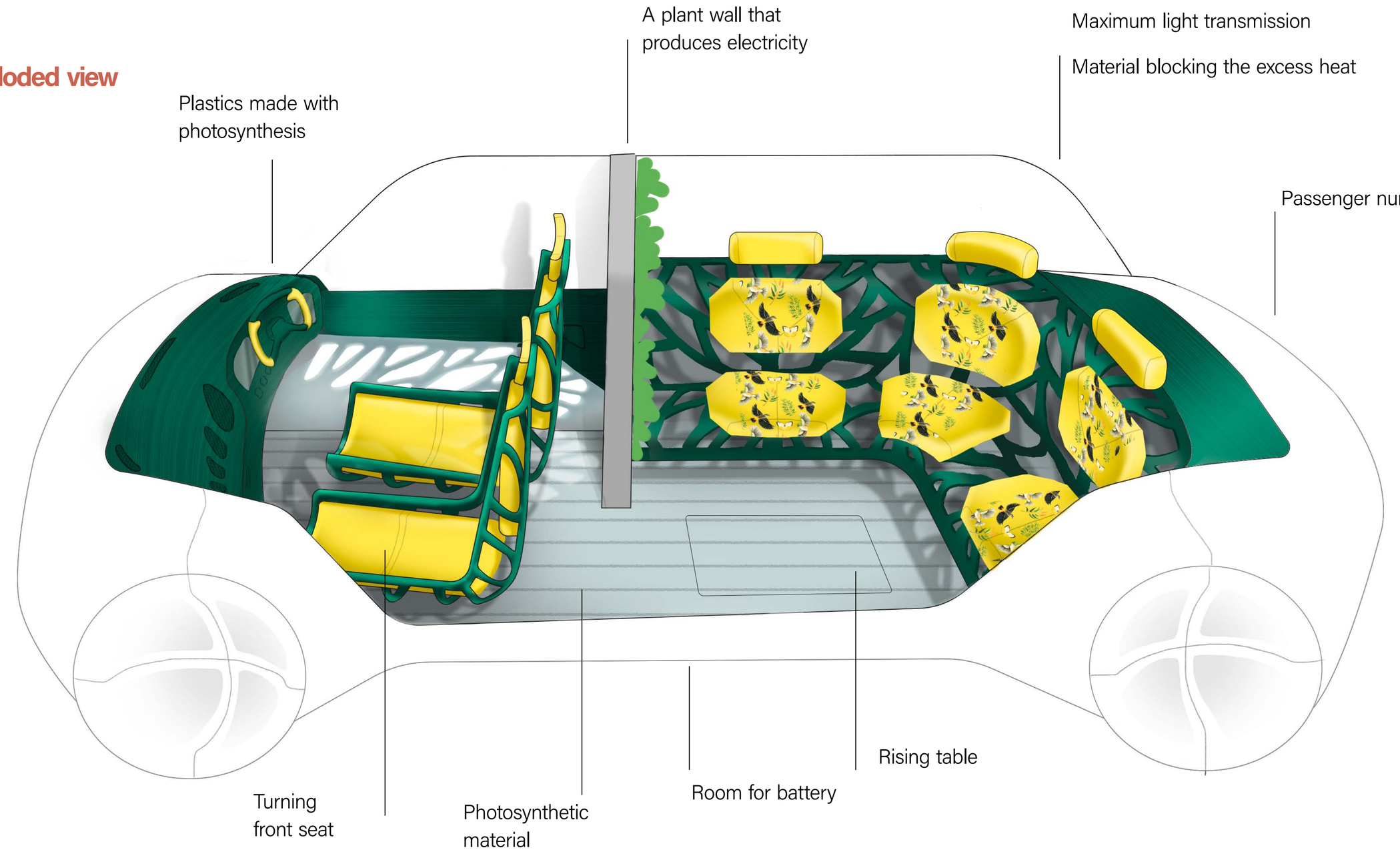


Image 55 Exploated view

Image 56 Dashboard render

Measurements & Package Drawing

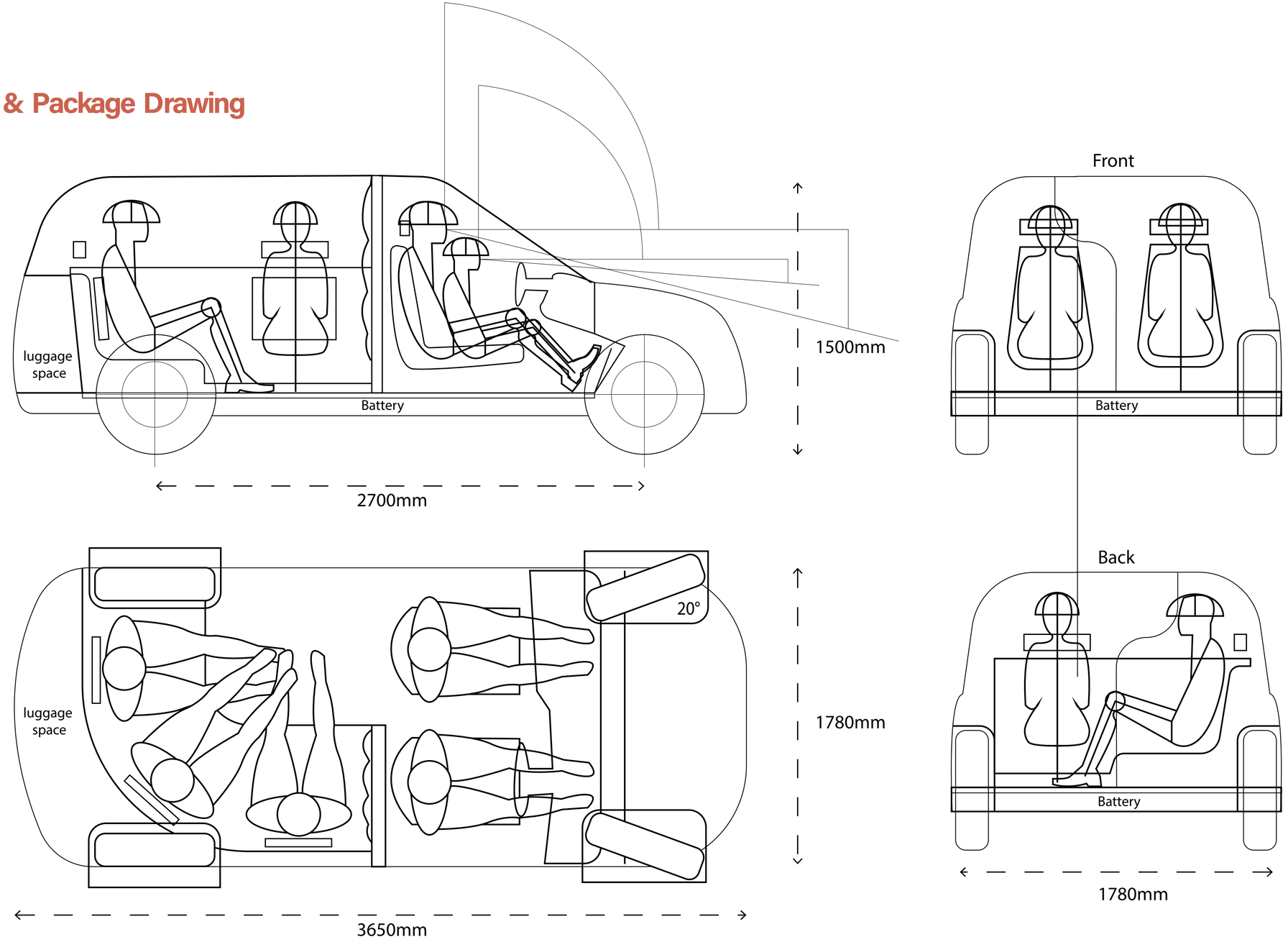


Image 57 Measurements & Package drawing

06.2 Functions

Air vents

Speacers

Storage locker

Pedals

Photosynthetic material

Head up display

Control panels

Window

Door handle

Transparent door

Image 58 Driver view render

Plant wall

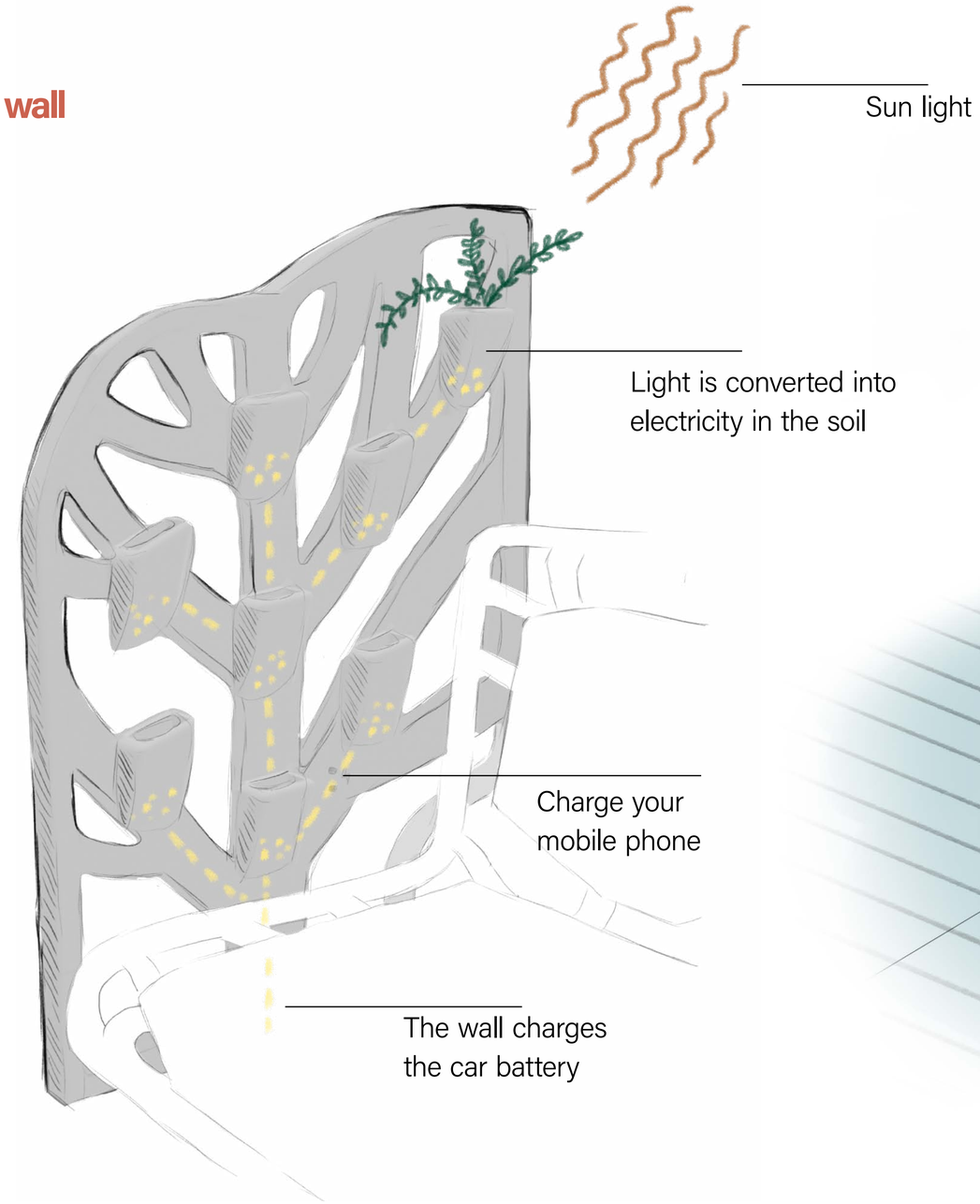


Image 59 Plant wall functions

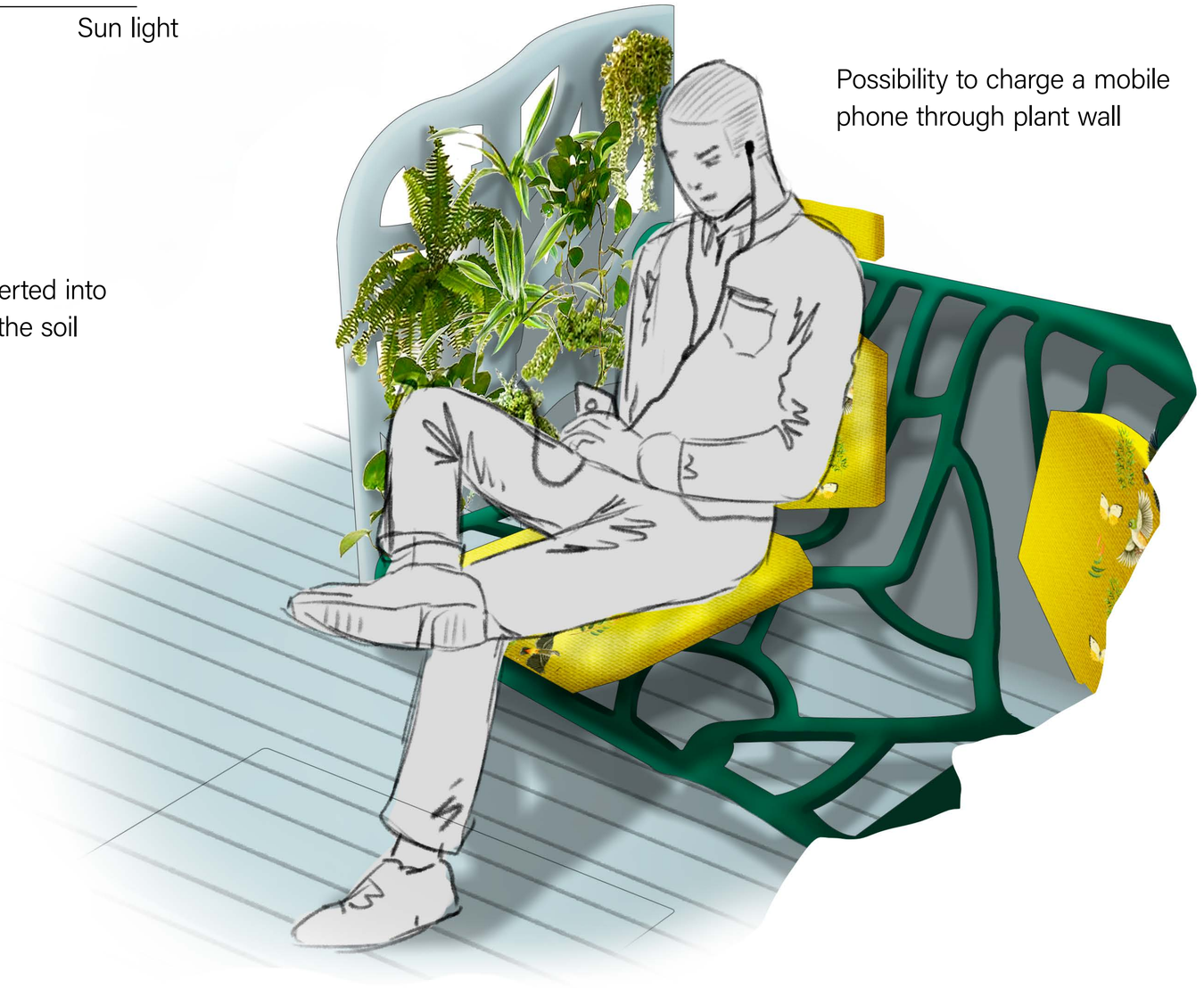


Image 60 Using plant wall

Floor

Transforming solar energy to electricity with photosynthesis and charging the battery. Charging the vehicle is still needed but this makes the vehicle more self-sufficient by getting energy also from the sun.

This technology could possibly absorb carbon dioxide from surrounding air and reduce greenhouse gases and emit oxygen back into the atmosphere making the vehicle more environment friendly.

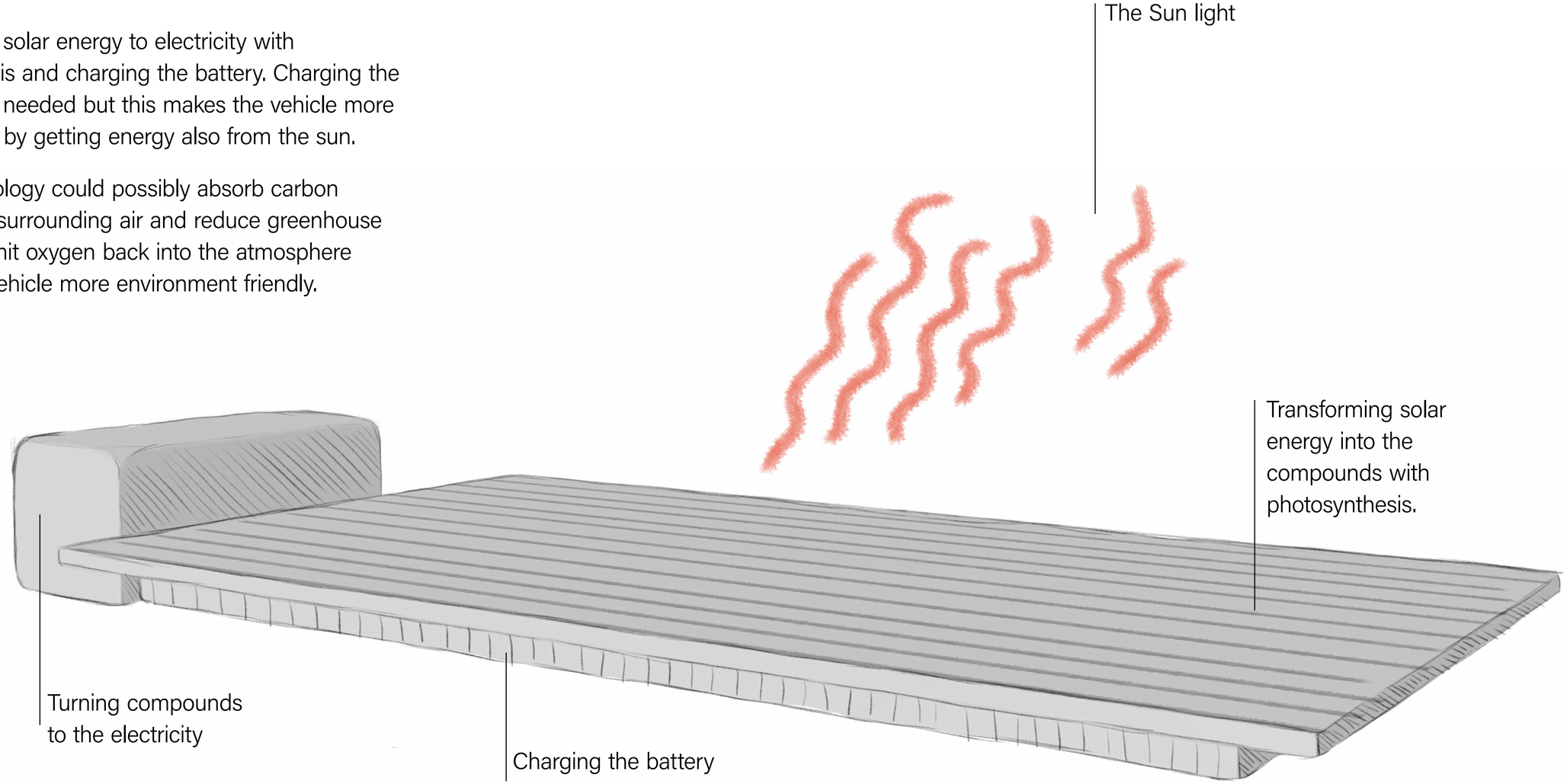


Image 61 Floor functions

Rising table

To create comfortable and useful working space for users a table was added. To increase space usage.

Image 63 Top view render

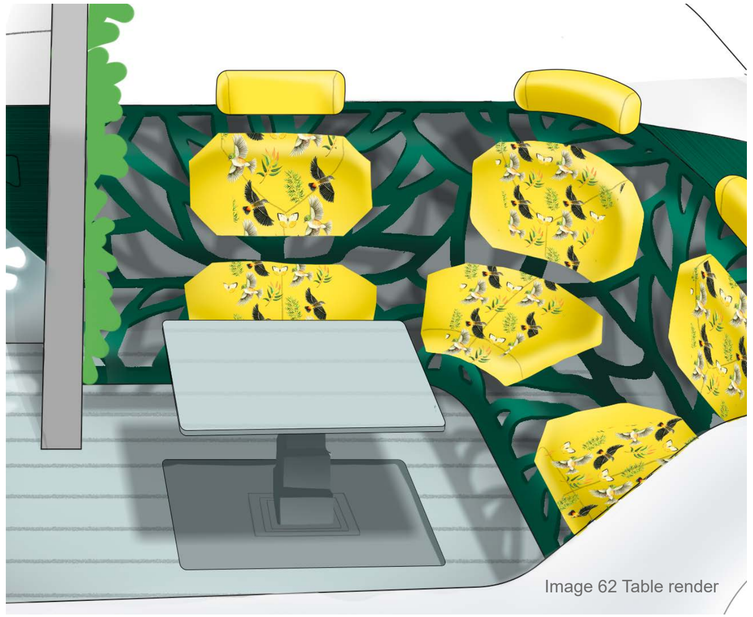


Image 62 Table render

A table that rises to a working space.

Turning seat

I wanted to make the front seat able to turn backwards. To create a small and comfortable communal space for working or socializing.

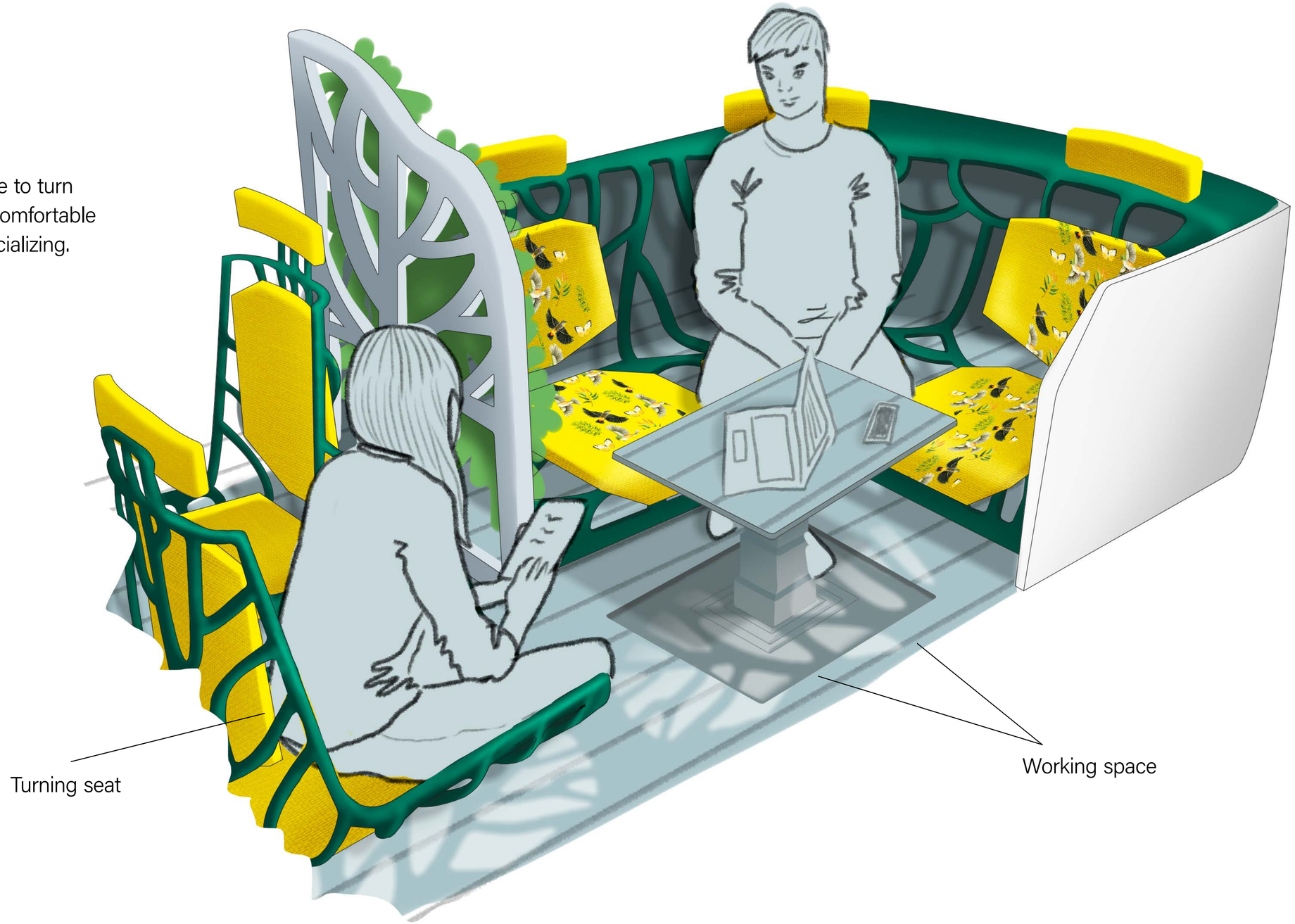


Image 64 Working space render

Seven
Summary

Process & methods

With this project I wanted to learn and make something new. My first goal was to learn 3D modelling. I also wanted to challenge myself with interviews and surveys that I have never done all by myself before.

Difficult part was to understand the secrets and possibilities of photosynthesis. After a while it got easier and I am grateful for all the help and insight that I got for that part. I had a clear vision what I wanted the concept to be. This being the graduation work made lots of pressure for me to create something that has at least some kind of value. I did not want to just to design a normal interior, it had to have something special to it. The most tedious part of this project was to evaluate the information that I found from the internet. I was very sceptical about everything. I hoped that I made the all the right decisions and understood everything correctly.

Starting the sketching process was very challenging and it took a long time to get the hang of it. Usually my working habit is to weigh different design options in my head and then only record "good" ideas on paper. Fortunately, however, I was able to use a 3D modelling program that clarified the situation for me.

3D modelling helped me to understand the perspective and the measurements more easily. My design language got inspired by natural shapes like leaves and branches, with those elements I was concerned that the interior would look too messy and crowded. I had to think what these elements would be that I wanted to apply those characteristics to.

Starting to do the 3D model was same time exciting and terrifying. I started to do it early as possible because I had to learn how to do it. I got hang of it faster than I expected. With 3D modelling, designing, and making changes was easier and faster.

Overall, I stayed in my schedule very well. There were times that I was falling behind but I always managed to catch up. I enjoyed the freedom that came with not having a client. It was nice taking my own time to decide every design decision, but on the other side it would have been nice to have somebody with me to support and criticize my decisions. After this proses, I felt that I was more knowledgeable about different research methods and more confident about my own work.

Image 65 Australian palants 2

Results

My passion for plants was the first step in creating this project. I acknowledged that I did not know much about plants like how they work. Everybody knows about the term photosynthesis, but I wanted to know how it worked. And could it be used for making more sustainable solutions.

The goal was to create a new kind of interior concept. Also bring a different user experience to the driver and at the same time make the vehicle more environmentally friendly. The direction of the concept turned more and more to create a new kind of user experience and not just designing vehicle interior that would use photosynthesis. Rendering the pictures of the design was hard and grasping the feeling that user would experience while using the concept was challenging. For the atmosphere to convey properly, one should really get to sit inside of the concept and experience it themselves.

After research and the realisation that self-sufficient vehicle using just photosynthetic materials could not be possible now, the design took a new turn. Possible to use photosynthesis in some other way in vehicle interior was introduced. Decision was to apply materials that would use end products of photosynthesis in their manufacture process into the interior design. That would make the vehicle more environmentally friendly with renewable materials. The photosynthetic floor material that generates electricity from the Sun was applied to bring new perspective and innovation to the concept. Collecting solar energy through plants with the plant wall was fun addition for the concept and the possibility to charge a mobile phone through it brought more interesting details into the concept.

The finished product clearly conveys its purpose and connection with nature and its photosynthesis properties subtly. The overall feeling and atmosphere of the concept worked well. The play of light and shadows on the surfaces create interesting details and an atmospheric user experience.

Image 66 Australian palants 3

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Section: 04.2 Australian Traffic Habits

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Appendices

Australian traffic habits

1. Where do you live in Australia?

2. What vehicle do you use most often?

- ☐ Own car
- ☐ Bus
- ☐ Tram
- ☐ Train/Metro
- ☐ Taxi / Uber ect.
- ☐ Bicycle
- ☐ Something else? What?

3. What is the most common transport in your city?

In this case when we speak about taxis, we are meaning traditional taxis, community cars in apartment complexes and Uber, Lyft or equivalent.

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Australian traffic habbits survey
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4. Is taxi commonly used in your city?

- ◯ Yes
- ◯ No
- ◯ I don't know

5. Can you tell about taxi culture in your city?

6. Who uses taxi services?

7. In what circumstance would you use a taxi?

8. Would you like to use more ecological transportation?

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Australian traffic habbits survey
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9. How long do you spend commuting per day?

- ◯ 5 min
- ◯ 10 min
- ◯ 20 min
- ◯ 30 min
- ◯ 45 min
- ◯ 1 h
- ◯ 1,5 h
- ◯ More ?
- ◯ 0 min

10. Do you work while commuting?

- ◯ Yes
- ◯ No

11. Estimate your average weekly traveling distance

12. Estimate your average weekly time spent traveling

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