

Design Project III

# Solar Vehicle of Enhanced Delivery Transport For The Postal Department



**IDC** School of Design  
अभिकल्प विद्यालय

Guide by : Prof. Nishant Sharma

Submitted By

**Deolekar Gaurav Sanjay - 196390008**

Mobility & Vehicle Design

IDC School of Design, IIT Bombay

# CONTENTS

<b>1. Introduction</b>	1
<b>2. Pre Research</b>	2
2.1 Motivation	3
2.2 India Solar Vehicle	4
2.3 Gantt chart	8
<b>3. Research</b>	9
3.1 Solar Energy Project	10
3.2 Solar Technology	15
3.3 Solar Mobility	18
3.4 Solar Vehicle	22
<b>4. Product study</b>	24
4.1 List of vehicles used in the Postal department	25
4.2 How the postal department in the Indian scenario	30
4.3 Logistics Post: Delivery of parcels	35
<b>5. User Study</b>	37
5.1 Interview with postmans	38
5.2 User Research with Vehicle	40
5.3 Type of Vehicles used in the IIT Powai post office	41
5.4 Customer journey map	42
5.5 Problem Identified	44
5.6 Key Insight	44
<b>6. Design Process</b>	45

6.1 Design Brief	46
6.2 Key Packaging Architecture	47
6.3 Vehicle Ergonomics and Driver's height & posture	49
6.4 Indian Anthropometric Data For Sitting & Standing Dimensions	50
6.5 Layout Concepts	51
6.6 Cargo Storage Volume	52
6.7 Package Ideation Process	54
6.8 Final Technical Package Dimensions With Exterior Ideation	56
6.9 Interior Ergonomics Package	59
<b>7. Design Concept</b>	<b>62</b>
7.1 Interior Design Moodboard	63
7.2 Interior Cargo Layout Sketches	64
7.3 Interior Design Concept (Cad Model)	68
7.4 Concept Evolution Of Interior Design	79
7.5 Exterior Design Moodboard	80
7.6 Exterior Design Ideations	81
7.7 Proposal Exterior Concept	86
<b>8. Final Concept Details</b>	<b>92</b>
8.1 Final Concept Render	93
8.2 Final 3D CAD Model	97
<b>References</b>	<b>110</b>
<b>Appendix</b>	<b>111</b>

# 1. INTRODUCTION

The solar ecosystem in India has come a long way and is further evolving to become self-reliant on technology, manufacturing, hardware supplies and financing to fuel continued growth. Solar policies on generation, transmission, banking and net-metering require more attention from the government sector.

India is expected to emerge as the world's third-largest passenger vehicle market by 2021. This shift to EVs is expected to happen over the next 10 years. As the cost of solar cell technology decreases and efficiency increases, the notion of solar panel vehicles has even gained traction among car manufacturers.

Solar panels represent one way that sustainable tech can be integrated into homes. Other examples include the installation of charging points for electric vehicles.

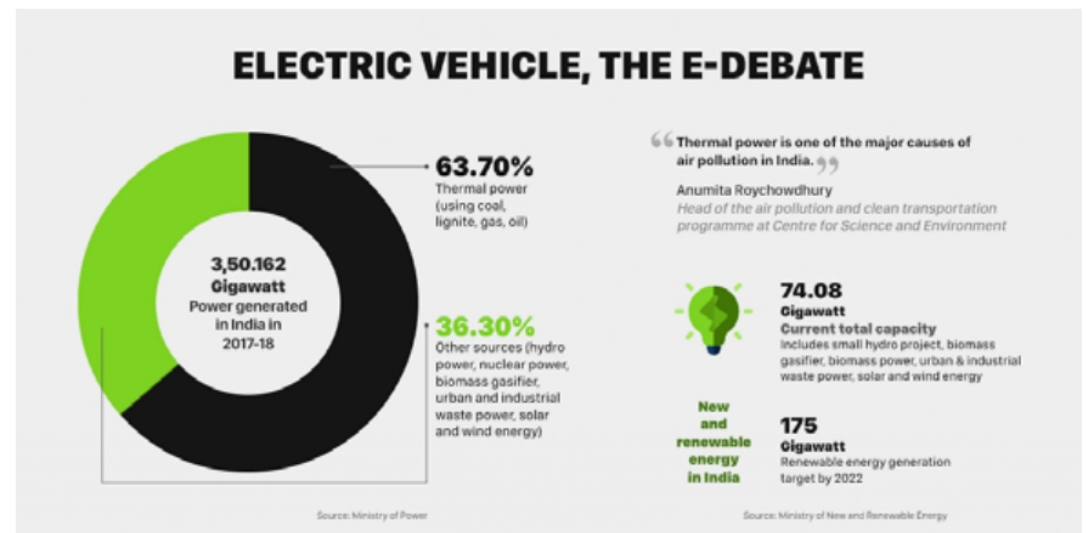
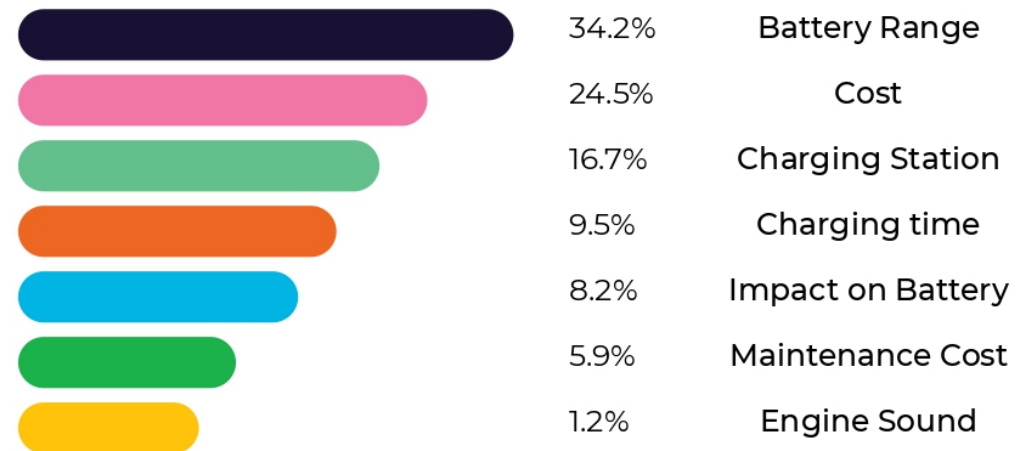
## **2. PRE RESEARCH**

Prior to showing up at the thoughts and the ideas, a pre research was done through the web and paper articles. Pre research will prompt experiences which will be utilized to derive design brief.

## 2.1 MOTIVATION

- Limited charging station
- Limited Battery time
- No EV across in the rural areas
- Higher Upfront Cost
- Difficulty Finding a Mechanic
- Limited choice
- No E-utility type vehicles

### Matters to Buy EV Vehicles



## 2.2 INDIA SOLAR VEHICLE

What has already happened in the India?



Sun Run Motors Auto Rickshaws



Self-Driving Solar-Powered Bus



Solar Powered Mahindra Reva

Solar Vehicle of Enhanced Delivery Transport For The Postal Department



Indian Railways Solar-Powered Coaches

## India's Solar Vehicle Challenge set to take place in 2022

### The solar transformation of electric vehicles

#### Transportation Cost



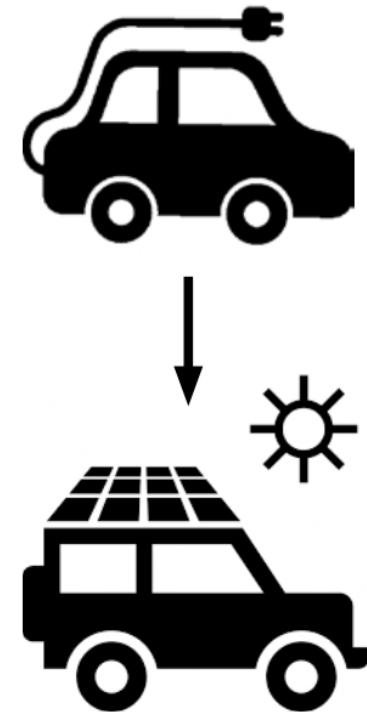
**Efficient Gas Vehicle:**  
15.7 cents per mile



**Electric Vehicle:**  
2.9 cents per mile



**Solar Powered EV:**  
0 cents per mile

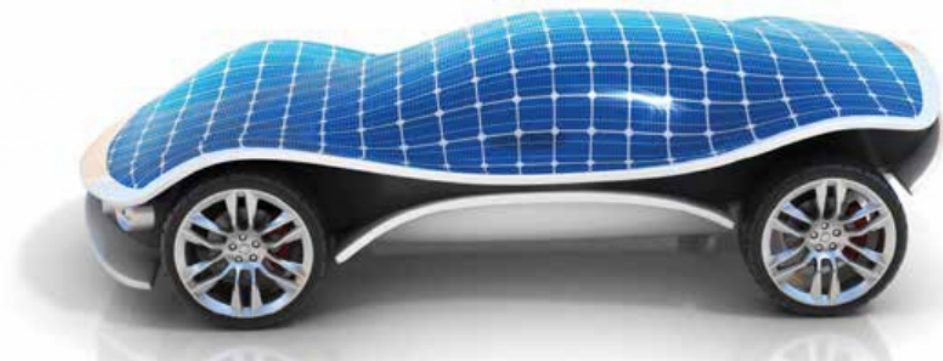
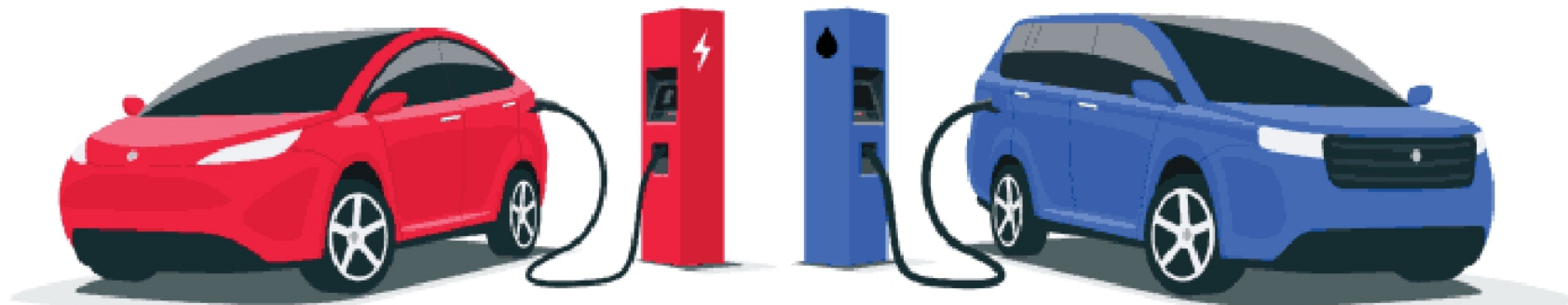


**FUTURE OF MOBILITY**



## What's new you will possibly bring for India?

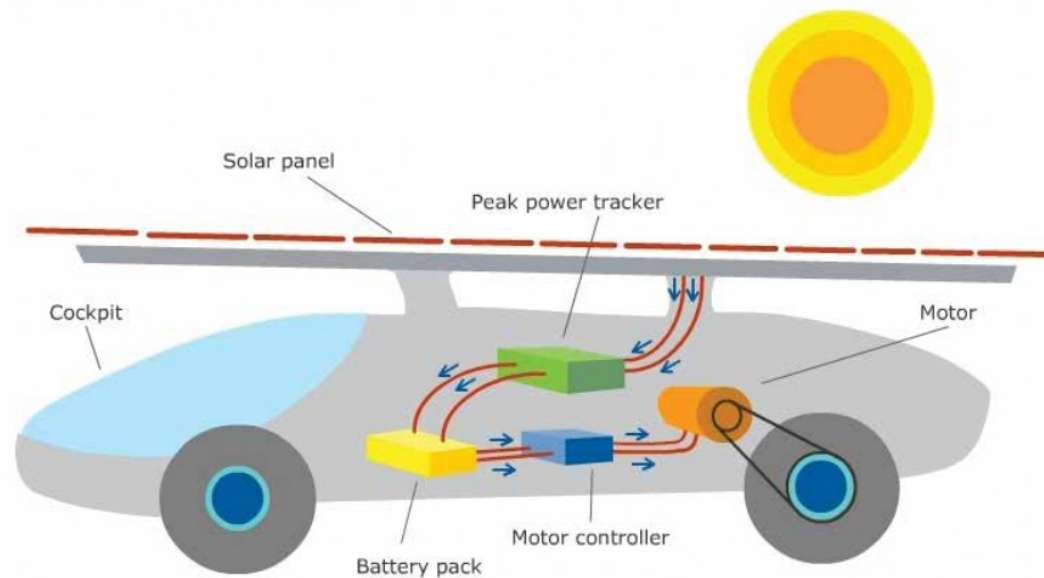
- The solar-powered vehicle could be a reason that motivate an individual to move towards a sustainable way of life for Indian people who want to drive a next-generation electric vehicle for delivery purpose
- **Solar-powered postal vehicle services** will help to deliver letters and parcels in rural areas and it will become a dependable option for the urgent delivery of essential commodities. Also for the importance of the last-mile reach of postal workers across the country



- Few of the major competitors currently working in the global solar vehicle market are many automotive companies in India.
- This Rise In Market Value Can Be Attributed To The Increased Levels Of Investment Undertaken By The Manufacturers Of Vehicles To Promote Environmental-Friendly Modes Of Transportation.
- **Solar charged battery electric vehicle is expected to be available starting in 2021, currently no cars primarily powered by the sun are available commercially.**
- Solar powered vehicle will help increase the life of vehicle batteries and reduce greenhouse gas emissions.

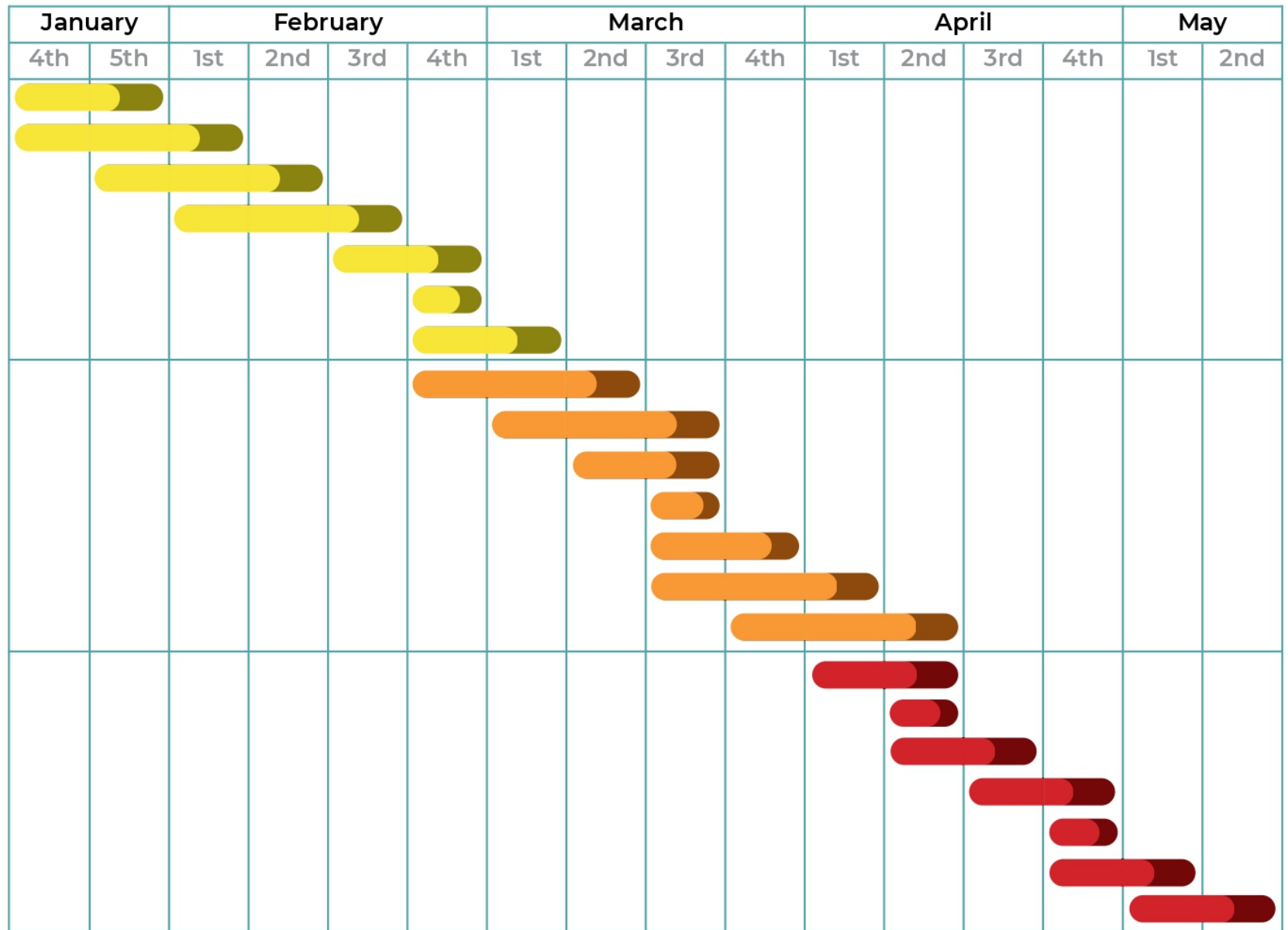


## How do solar cars work?



## 2.3 GANTT CHART

### Weekly Timelines



### Stage Timelines

Stage 1 Jury

Stage 2 Jury

Final Jury

### 3. RESEARCH

In this research, a study on past, present, and future solar energy applications, has been presented to the main issue of the solar car, technical parameters. This work aims to estimate the potential of energies, solar energy, and IC engine power. Both powers will be utilized in near future work.

A solar car is a solar vehicle used for land transport. Solar cars combine technology typically used in the aerospace, bicycle, alternative energy, and automotive industries. The design of a solar vehicle is severely limited by the amount of energy input into the car. Most solar cars have been built for solar car races. Since 2011 also solar-powered cars for daily use on public roads are designed.

## 3.1 SOLAR ENERGY PROJECT IN THE INDIA



**Cochin International Airport Limited (CIAL)** major floating solar power plant

- **Generating green energy**
- **Cost-effective high density polyethylene floats using French technology.**
- **To reduce carbon footprint**
- **Sustainability Management**



Solar Panel Set Up Will Light Up **Rural Homes In Maharashtra**

- **To take up jobs and earn a livelihood**
- **Towards sustainable employment**
- **To increase street lights in rural area**



India Can be the **next Solar Manufacturing hub**

- **Powering industrial and technological growth**
- **Bringing in socio-economic growth**
- **To build something great that will lead the country out of darkness.**

## India's Largest Integrated Solar Company

- **Tata Power Solar Systems Ltd.**

- To build **320 MW** of ground mounted Solar PV project for NTPC
- To develop a **110 MW** solar project from KSEB



- **Kerala State Electricity Board (KSEB)**

- To achieve solar power generation to the tune of **1,000 MW by 2022**



- **Adani Green Energy Ltd. (AGEL)**

- Focus on timely project delivery and our long-term vision to achieve renewable capacity of **25 GW by 2025.**



- **Vikram Solar**

- Commissioned a **10 MW solar project** for West Bengal State Electricity Distribution Company Limited (WBSEDCL).
- Introduces with **advanced M6 cells** in India and across the globe



## Future Of Solar Energy Project In The India

There has been a visible impact of solar energy in the Indian energy scenario during the last few years.



- Solar: 100 GW
- Wind: 60 GW
- Biomass: 10 GW
- Hydro: 5 GW



**By 2022**



**India's renewable energy ambitions**



**Switch to cleaner fuels**



**Generate Renewable Energy**

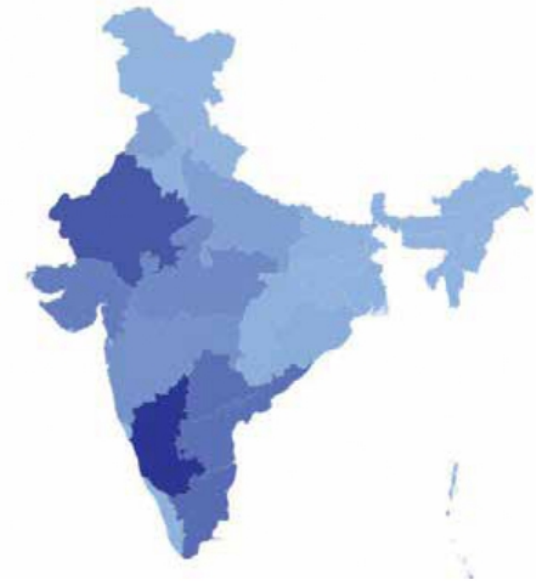


**Solar Household**

- **To meet the demands of the ever growing population.**
- **To boost the production of solar energy that would solve the energy deficit in the future.**

## Total Solar Pv Capacity In Worldwide

S. No.	Country	Solar PV Capacity (MW), as of 2019
1	China	204,700
2	The United States	75,900
3	Japan	63,000
4	Germany	49,200
5	India	42,800
6	Italy	20,800
7	Australia	14,600
8	United Kingdom	13,300
9	South Korea	11,200
10	France	9,900

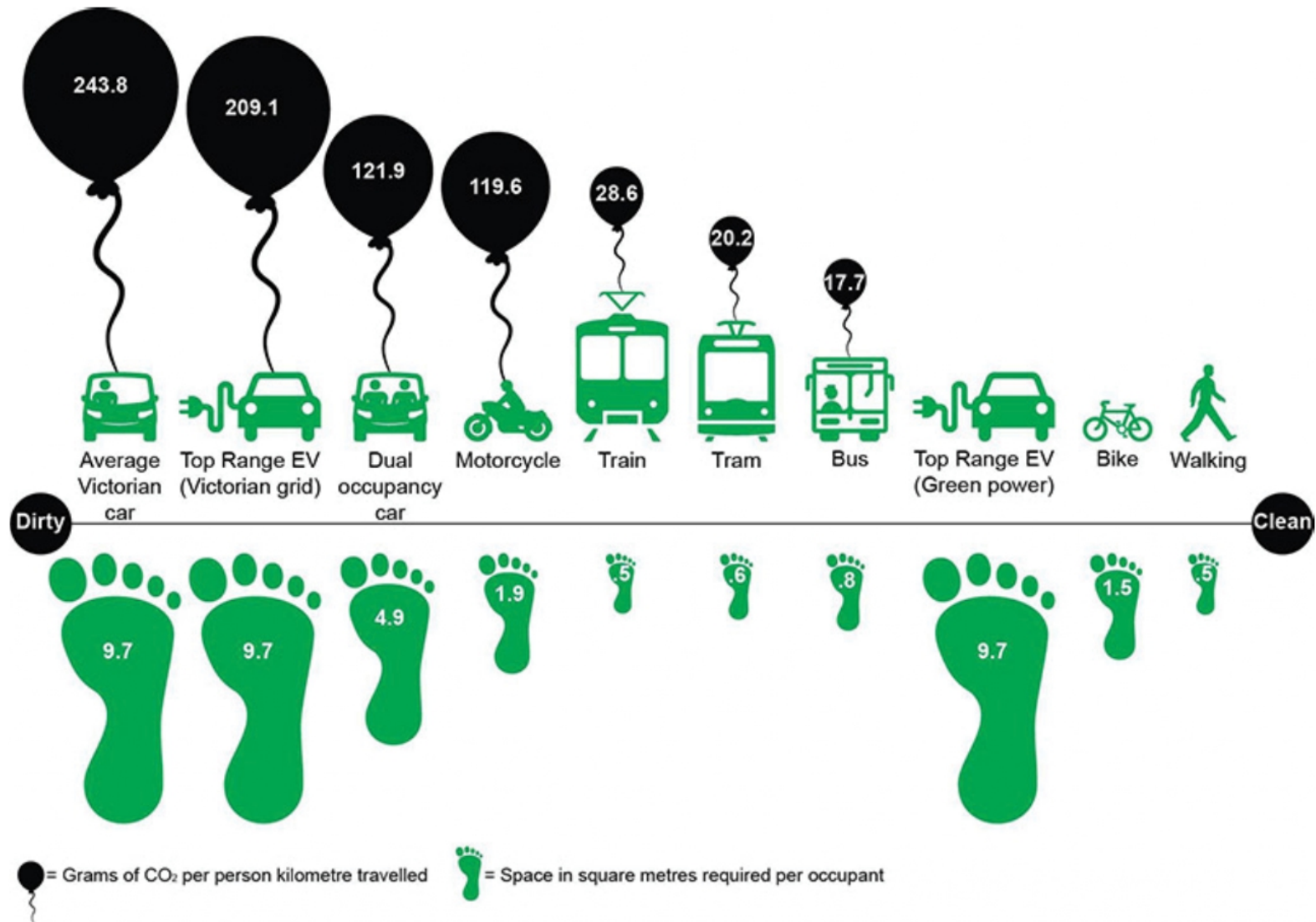


+  -  
Total Solar Power Capacity in the  
India

- **Recently, India achieved 5th global position in solar power deployment by surpassing Italy.**
- **Presently, solar tariff in India is very competitive and has achieved grid parity.**



Solar power is one of the best ways of reducing carbon footprint worldwide.



Source : <https://sensibletransport.org.au/project/transport-and-climate-change/>

## 3.2 SOLAR TECHNOLOGY

- **Electromobility** is an emerging global trend and will open a world of new and exciting opportunities for solar.
- From solar-powered vehicles to solar-powered charging stations, to the development of innovative solar-powered supply offers, solar will help facilitate the electric mobility revolution.



- **Electromobility** is the key to world's transition to low-carbon transport, however, world must make sure that the electricity used for e-mobility is generated from renewable sources, and solar in particular.
- The solar mobility revolution presents many benefits and will bring together the transport and the energy sector.

## SOLAR-MOBILITY



## SOLAR-TECHNOLOGY



### 3.3 SOLAR MOBILITY

- It is therefore urgent to make transport more sustainable.
- Solar energy is the ideal candidate to fuel green, electric mobility.
- In light road transport only, a typical rooftop, 5-kW solar panel can easily produce the daily amount of electricity needed for the average commute of an electric vehicle
- Solar energy is also a cost-competitive fuel for transport.
- **“Solar mobility”** refers to all the models exploiting the synergies between solar energy and clean transport



Solar Vehicle of Enhanced Delivery Transport For The Postal Department



## Solar Mobility is also Benefits for Better transport



**Up to 65% lower energy costs**



**Increase self-consumption of solar power**



**Climate and resource friendly mobility with no fossil fuels**



**Combine all household loads in a single system**

## Why Solar Mobility need for future transport system ?

### **Solar mobility is emissions free**

No CO2 emissions

No noise pollution

No NOx (nitrogen oxide) emissions



### **Solar mobility is energy efficient**

Electric motor provides more than twice the energy output

Very little noise

No polluting chemicals



### **Solar mobility is resource efficient**

Unlimited and produces no pollutants

Photo-voltaic charging stations also produce solar energy



### **Solar mobility is space efficient**

More mobility

Can supply up to 100 electrical cars



## This How Solar Mobility system will work in the Post Office !



### Solar E-Mobility & Storage

- Document Parcels storage
- Battery storage
- Vehicle-integrated PV



### Solar Rooftop Post Office

- Solar Mini-grids
- Fully solar operated bank
- Solar electricity supply



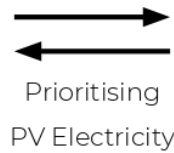
### Solar Charging Station

- Solar smart charging
- Charging infrastructure
- Power generation



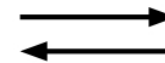
### Vehicle

Battery charging  
Mobility, Power storage



### Solar Panels

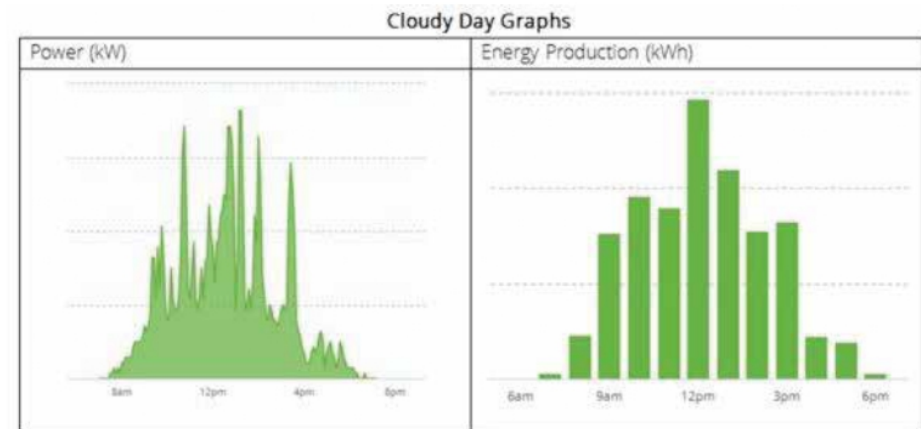
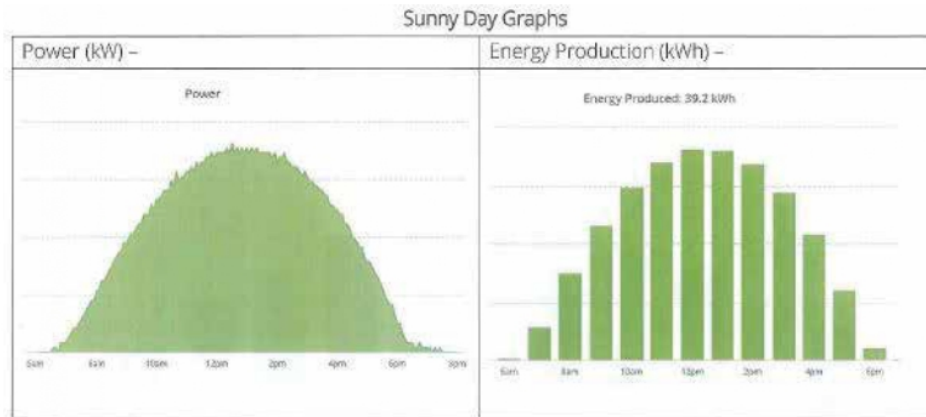
On a solar energy Post Office  
Car Charge at office



### Smart Grid

Data on grid load and power  
needs

## How can make the vehicle smarter utilizing the Solar technologies



### What happens to solar panels when it rains?

- Since solar energy output is directly affected by season and weather variations, it's obvious why this is a common concern.
- On a typical clear, sunny day, solar system's power graph forms a bell curve, with the highest energy production around noon, when the sunshine is greatest.
- Solar panels operate most efficiently on these days.
- Rain also helps wash away dust on panels to keep them operating efficiently.

### How well do solar panels work on cloudy days?

- Solar panels still work on cloudy days
- Solar panel can still get sun energy on cloudy days, Solar panels could still be producing electricity, depending on how thick the cloud coverage is.
- The amount of electricity generated is dependent on the density of cloud cover.
- They can still use diffuse or indirect sunlight (radiation) to generate energy.

Source : <https://www.greenconvergence.com/blog/2018/march/do-solar-panels-work-on-rainy-days/>





## 3.4 SOLAR VEHICLES

### Study On Types Of International Solar Vehicles



#### Lightyear one

- Long range solar electric vehicle
- Designed to be grid independent
- Its unique vehicle architecture and technology
- Developed with high efficiency in mind.
- Lowest charging frequency



#### Aptera EV

- Very airplane like design
- Three wheel drive version
- Never have to plug it in charging
- Ultra light vehicle



#### Sono Motors Sion

- Charged using the electric grid or solar cells.
- Photovoltaic modules integrated into the outer skin
- Can charge its battery during the day through the power of the sun
- Passenger Solar Vehicle

## System Configuration of Solar Vehicles

	Lightyear one	Aptera EV	Sono Motors Sion
Solar Range	Up to 65 km/day	Up to 64 km/day	Up to 35 km/day
Total Range	Upto 725 km	Upto 1600 km	Upto 255 km
Battery pack	60 kWh	100 kWh	35 kWh
Solar Cell	1,000 solar cells	180 solar cells	248 solar cells
Charging	44 min to 100%	35 min to 100%	30 min to 80%
Drivetrain	100 kW Motor	50kW DC	120 kW Motor
Torque	1200 Nm	1500 Nm	270 Nm
Max. Speed	150 km/h	177 km/h	140 km/h
Storage	780L	708 L	650L
Price	1.2 Crore	19L-34L	22L-25L

## 4. PRODUCT STUDY

A product study was done to see how these Different types of vehicles are used for delivery the parcels in different cities, what occurs if packages exceed, which vehicles are usually utilized. How they access crates at a delivery place, access other devices, maintain other types of Parcels, etc.

The product study was useful for seeing how a Postman connects with their vehicle and what issues they face while getting to the cases.

## 4.1 List of vehicles used in the Postal department

The purpose of the product study is to know the current and the most used vehicle in the India Postal Department, its dimension and volume. This study will help me in benchmarking the design and also for conducting research.

### Maruti Suzuki Eeco

Exterior



Dimensions

Length: 3675 mm  
Width: 1475 mm  
Height: 1825 mm  
Wheelbase: 2350 mm  
Boot Space: 275 liters

Interior



Mostly This vehicle used as delivery vehicle for the Indian postal department to delivers many parcels in different cities. Different parcels use in this vehicle with 1 driver and 2 postman workers. The interior has a bigger boot space and middle and boot space is used for storing the parcels.

## Tata SFC 407

Exterior



Dimensions

Length: 4850 mm  
Width: 2100 mm  
Height: 2770 mm  
Wheelbase: 2955 mm

Tata 407 is a light commercial vehicle. This truck vehicle used as logistics for the Indian postal department to deliver larger parcels in different states in the India. It is one of the best trucks for carrying general goods within the city including parcels, Box, Larger box and more.

Interior



## Tata LPT 1109

Exterior



Dimensions

Length: 5875 mm  
Width: 2313 mm  
Height: 2165 mm  
Wheelbase: 3600 mm

India's leading commercial vehicle manufacturer Tata has trucks to fulfill each and every need of the transporters and businessman. Being a country with varied terrains, it is required to transport goods with different load carrying capacity trucks and Tata's LPT 1109. Most of the Indian roads are bumpy, making it difficult for truck drivers to maneuver and deliver the goods on time.

Interior



## Current vehicles in the postal department of India



Indian Bicycle



Mail Services Van



Logistics post Truck

- India post has launched its road transport network in a bid to speed up its parcel delivery service.
- Transactions are increasingly happening on e-commerce, so parcels need to be reached across long distances.
- So long postal services delivery transportation system was dependent on airlines and railways and limitations deliveries are getting delayed.
- So for faster and secure delivery of parcels, India Post have started own transportation by road.
- With aspiration levels rising and Internet being available on mobile phones, parcel business will grow.

## Type of different vehicles in PAN INDIA





## 4.2 HOW THE POSTAL DEPARTMENT IN THE INDIAN SCENARIO

How the postal department uses vehicles and why?



**“India Post Goes Digital”**  
**1.5L Post Offices To Be Digitalized**  
**Handheld Devices For Postman**



**In one of biggest push for Digital India, Government has decided to digitalize 1.5 lakh post offices across India; which includes 1.3 lakh post offices in rural areas.**

**The image of the postman has been quite traditional as of now:  
a guy in khaki uniform carrying a brown bag on a cycle.**

- Postman across India would be provided with handheld devices, which would be connected with the national data centers via SIM card.
- It would be powered by solar power, and he would be trained to help the rural users to deposit money, withdraw money and provide financial services as well.



## Why does the Indian postal department use bicycles to deliver posts even today in spite of huge revenue it earns through postal deposits, etc.?

India post has three types of offices

1. Head post office
2. Sub post office
3. Branch post office

Postmen are able to deliver all mails in his/her area very smoothly, because, he/she has to deliver mail approx under 5km area.

**For better mail services, India post provided mobile to every postman for article updation.**



**That's why India post covers even rural areas all over India.**

## Nowadays Why India post uses bicycle for delivering speed, parcel etc.

- I have seen some postman using scooters now a days to deliver letters too at their own affordability.
- The staff have their own cycles to deliver letters.
- Private couriers only give separate allowance to deliver their letters and petrol charges also where as the postal department does not provide so.
- The average pay of a postman is around 12 to 15 thousand per month at most, and at this pay scale he cannot afford to use fuel/petrol for travel, since there is no separate allowance for travel or delivery of mail.
- Postman does not cover all the villages daily, mostly goes to a village a day or max twice in a week
- **Most of the MNC's are moving away from vans and either converting to green vehicles or bicycles for last mile delivery.**



Urban areas: 4,160

**Total Post Office: 23,344**

Rural areas: 19,184



**INDIA-POST is the only courier service that connects urban to rural India.**

## Future Solar Energy Project in the Postal Department India

### Department of Posts (DOP) in UP, India



- UP has started installing solar panels for ensuring uninterrupted power supply at its various post office establishments in the state.
- In the rural areas of Uttar Pradesh one gets power supply only at night. This had made it imperative to plan out installation of solar panels over post office buildings across the state.
- Most of the post offices in the rural areas of the state don't have generators and power cuts have become a major problem for post offices across the state.

### Two city post offices to go solar Chennai, India



- The postal department is all set to do its bit for the environment with a few post offices likely to go solar soon in Anna Nagar and Besant Nagar will be fitted with solar power units this fiscal.
- Postal Department said the move to shift to renewable energy had also improved functioning .

Source :

1. <https://www.hindustantimes.com/india/solar-power-for-post-offices-in-up/story-CuGLMDPuWQqIAO45I2kO7I.html>
2. <https://www.thehindu.com/news/cities/chennai/two-city-post-offices-to-go-solar/article17356530.ece>

## Powai IIT Post Office, Mumbai



**India Post IIT Powai,  
Mumbai, MH**

It is a sub office (S.O.). A Post Office (PO) / Dak Ghar is a facility in charge of sorting, processing, and delivering mail to recipients.

Powai IIT Dak Ghar offers all the postal services like delivery of mails & parcels, money transfer, banking, insurance and retail services.



24x7 booking  
facility



Across the  
world



High-Speed  
postal service



Mobile-Internet  
Platform



It also provides other services including passport applications, P.O. Box distribution, and other delivery services in Powai IIT.

Mails and mail services include all or any postal articles whose contents are in the form of message which may include Letters, Postcards, Inland letter cards, packets or parcels, Ordinary mails etc.

The premium services provided by Powai IIT Post Office are Speed Post, Business Post, Express Parcel Post, Media Post, Greeting Post, and Logistics Post.



## 4.3 LOGISTICS POST: DELIVERY OF PARCELS

### Full truck load (FTL) Services

- Uses a special network for carrying and delivering packages and consignments across the nation
  - It can send one parcel or multi-parcels

### Centres

- National Parcel Hub
  - Warehouse
- Logistics Post Centres
  - Post Office

### List of parcels

- Post card
- Letter Card
- Book Packets
- Registered Newspapers
  - Registration
  - Insurance
- Certificate of Posting
- Speed Post Money Order
- Post Box or Post Bag
- Business Reply Post Card
- International speed post

### Type of parcels



## Type of parcels used in the india post and understand the issues of delivery vehicles

(Small or big parcels, sizes of parcels & kind of material used)



## Parcel, Registered Parcel, Express Parcel and Speed Post Parcel



## 5. USER STUDY

The aim of this study was to understand the Postman. A few users were chosen at random for this study for qualitative analysis.

I interviewed the Postman at the Post office in the IIT Bombay Campus for understanding how the Postal service work. The survey helped in recovering data with respect to their utilization of the item and understanding the service in a better light.



## 5.1 INTERVIEW WITH POSTMANS

### User 1

Nodal Department (where parcel from)

Daily trips: ghatkopar-powai-barve nagar-bhatwadi-Hiranandani

Small van

Type of parcel: Book, Bank documents, small parcels.

3 peoples: 1 driver, 2 delivery persons

Delivery work-time: 8 A.M-8 P.M

Age can be 25 to 60

Front 2 seat, 1 in the back

Comfortable with current vehicle



### User 2

Works as to finding parcels and deliver to address

Difficult to lift parcels

Still Uses Documents for verification package

They pick up and off-load the parcels using one/two loaders max.

They are ensuring minimum contact during the transit.

Mostly busy in the working time.

Sitting arrangement for them in the Van is not properly.



## Study of postmen and understanding their issues



### Chandra Bhusan Shukla, 59 years

- Serving for 30 years as Postman.
- When he had started out, he would go around on his cycle with a bag of letters bursting at the seams.
- In the past few years, he spent more time at his desk than he did outside.
- “Medicines, cash, insurance, pension, government papers,” the contents of his bag these days as he moves across 16 villages under his post office.
- Postmen have also been delivering Covid-19 essentials.



### Rajendra Meena, 30 years

- He go into containment zones to deliver medicines and other essential items.
- He cannot sanitise all packages, but he wear a mask and gloves.
- We deliver pension at the doorstep for widows, physically challenged people and senior citizens.
- The postal services have also tied up with e-commerce sites for delivery of orders placed online.
- Because of the pandemic he happy my bag is full again.”



### Haroon Allahuddin Sheikh, 60 years

- He worked in this Nashik area for a long period of 36 years.
- He used to read letters and hand over the money orders coming mostly from relatives settled in Mumbai.
- With postman become irrelevant in the age of emails and mobile phones.

## 5.2 USER RESEARCH WITH VEHICLE



India Post IIT Powai,  
Mumbai, MH

Maruti Suzuki Eeco of India post vehicle spotted in the post office where a postman was delivering a parcel to the IIT Powai Post office.



## 5.3 TYPE OF VEHICLES USED IN THE IIT POWAI POST OFFICE



- Difficult to finding parcels
- Packaging is not proper
- Left Front seat is also used for storing parcel
- Difficult to sitting for them
- Conformable with this Van

- Cycles used for deliver lightweight parcels
- Old cycle tube used for attaching parcels
- Still using old cycles
- Now-days no. of cycles reduced due to rise of online platform

- Fast Delivery Truck
- Loading large parcels
- Safety is not good
- Connected to all post office
- Used to deliver foods & medicines during pandemic

## 5.4 CUSTOMER JOURNEY MAP

### By Truck or Van



India Post van picks up packages from state warehouse



India Post van delivers packages to the district



Customer receives packages

### By Bicycles or Two wheeler



Postman goes to the Parcel hubs to get parcels

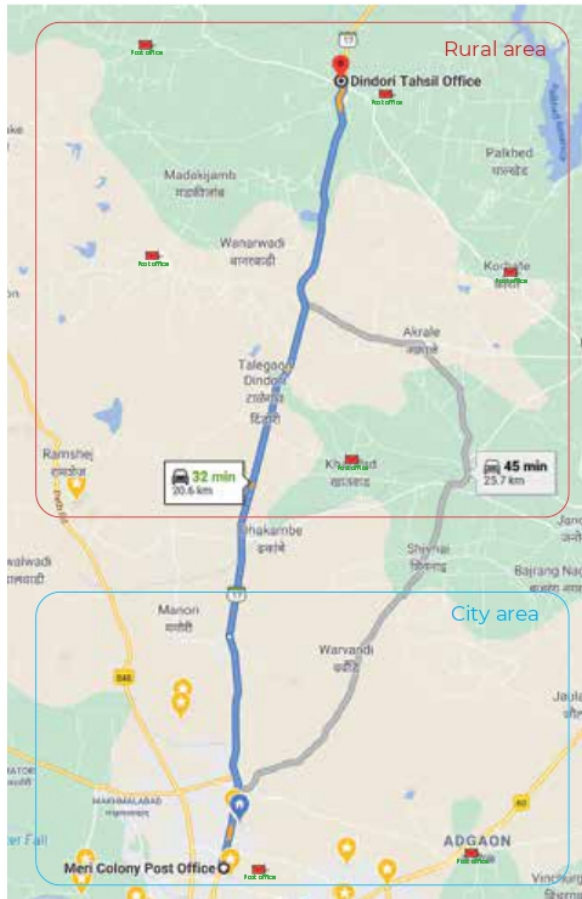


Postman checks every parcels at the Post office

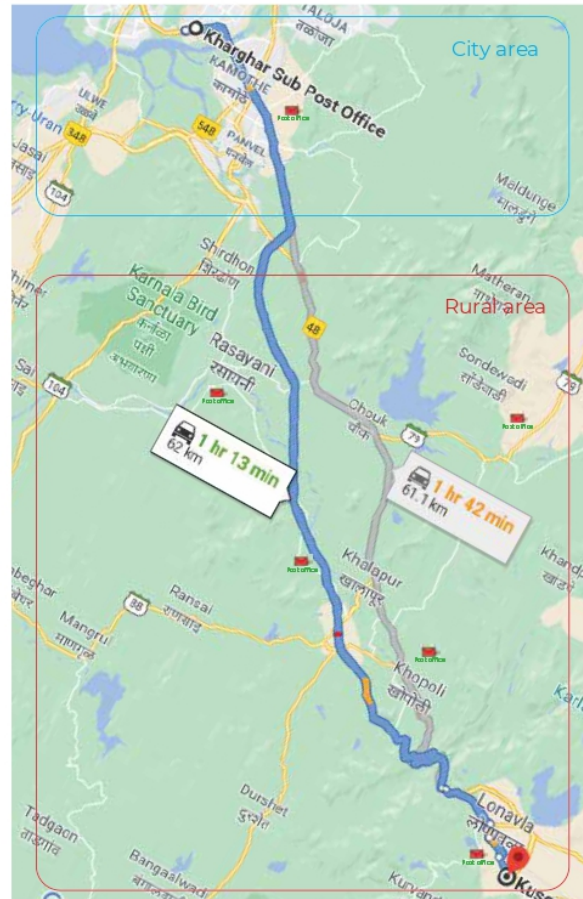


Goes to the small cities or small villages to delivers the parcels

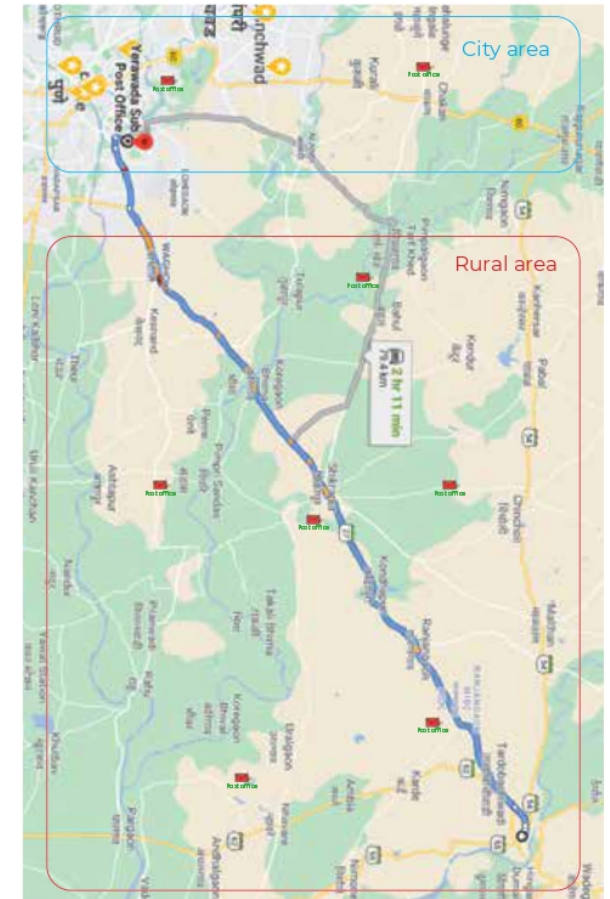
## Route of post office to deliver parcels from city to rural area



Nashik region



Mumbai region



Pune region

## 5.5 PROBLEM IDENTIFIED

- In the Covid-19, postal department are trying to reach the elderly in their homes so they do not have to step out. India postal department was tried to refine services.
- There are also limited transport post department vehicles in the rural area due to lack of fuel station on the roads.
- It is difficult to store parcels in the vehicle due to a lack o interior design.
- Also difficult for the postman to sitting around parcels in a vehicle.

## 5.6 KEY INSIGHT

- There is a need for a solar delivery vehicle that makes them to across all states and villages in India and deliver parcels on the time.
- There is a need to design an interior layout that storing parcels in different sections.
- To get a Comfortable seat for both driver and postman worker.
- Need to protect the box for delivery cash in the parcels.

## **6. DESIGN PROCESS**

To design a post office Hybrid minivan with solar energy powered for India post to enhance parcel delivery transport.



## 6.1 DESIGN BRIEF

To design a post office Hybrid minivan with solar energy powered for India post to enhance parcel delivery transport from city to rural area which can help to better deliver mails/parcels services, increase cargo capacity and which to be much more comfortable for 3 postmen. (Fuel-efficient internal combustion engine type van and small solar roof will be added on the roof of the van for electronic purpose)

### Primary Considerations

- Solar Charging System for Battery
- Storage - space to carry all parcels things
- Better Compact in size (compared to any minivan)
- It should have access to all parcels and good finding parcels in the van for the postman
- It should be easy and comfortable to be used by both driver and postman
- It should have storage space organization

### Concept Dimensions:

- Length: 4200 mm
- Width: 1470 mm
- Height: 2000 mm

### Secondary Considerations

- Cleaner and more efficient technologies
- Weather protection
- Adjustable seat
- Back-up cameras for safety purpose (360-degree cameras)
- It should have equipped with off-road wheel for a run on different condition of roads
- It should have equipped with laptop to connect computerizing and networking of all post offices for better services

## 6.2 KEY PACKAGING ARCHITECTURE

As the key factors are analyzed and it helps to design a package and vehicle for Postman



# Dimensions of Maruti Suzuki Eeco Cargo

The Eeco Cargo is equipped for any business need with a completely covered cabin space, good load bearing capacity and flat bed for stability for goods. Have a Covered Cabin, Ample Cargo Space, Safety Cargo Cabin With Flat Bed

## Dimensions

Length : 3675 MM  
Width : 1475 MM  
Height : 1800 MM  
Wheel Base : 2350 MM  
Track Front : 1280 MM  
Track Rear : 1290 MM

## Cargo box dimensions

Length : 1620 MM  
Width : 1300 MM  
Height : 1070 MM

**Price** : 4.5 lakh

## Seating capacity

Driver + 1

## Fuel tank capacity

Petrol (40 L)

## Kerb weight

920 KG

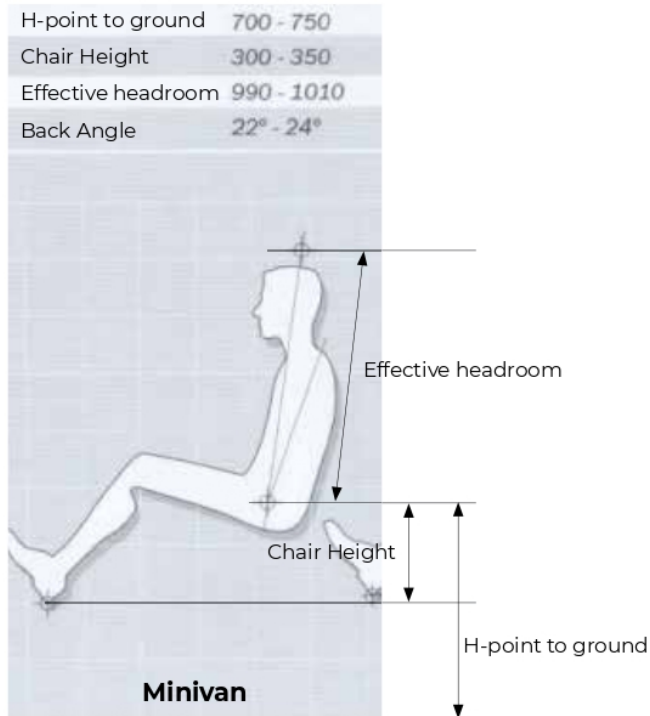
## Gross Vehicle Weight

1540 KG

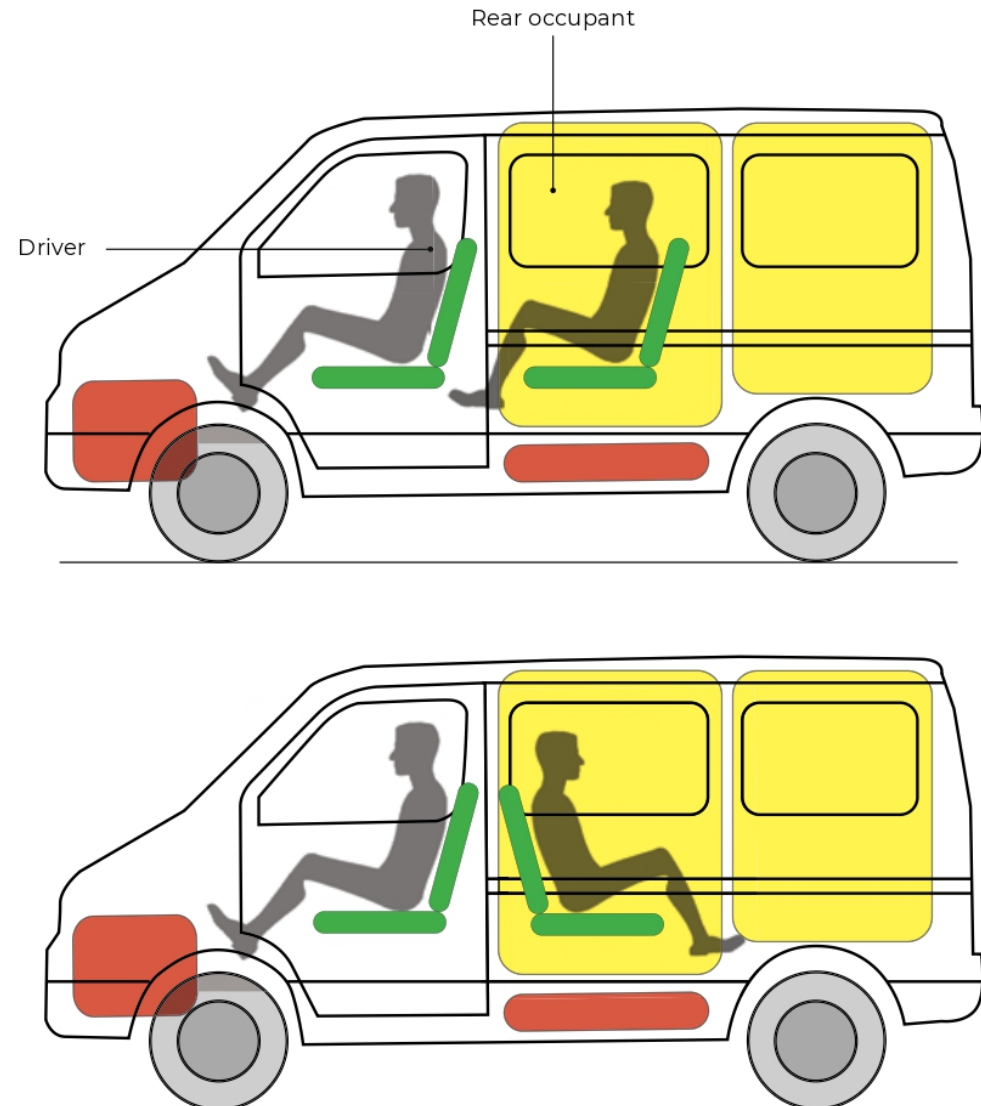


## 6.3 VEHICLE ERGONOMICS AND DRIVER'S HEIGHT & POSTURE

Driver's height & posture with SAE 95th percentile and considering height from the ground and seating posture.



Usually set up quite high to provide a sense of security and good visibility. The tall chair height also helps to create an efficient package and provides excellent ingress and egress.



## 6.4 INDIAN ANTHROPOMETRIC DATA FOR SITTING & STANDING DIMENSIONS

For designing seat for driver & postman and selected dimension from 5th percentile female and 95th percentile male in the table.

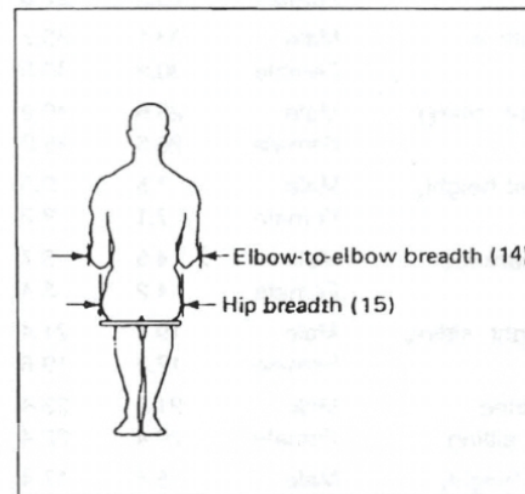
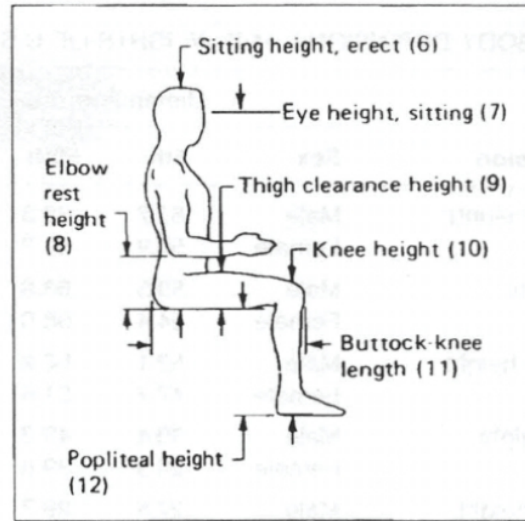
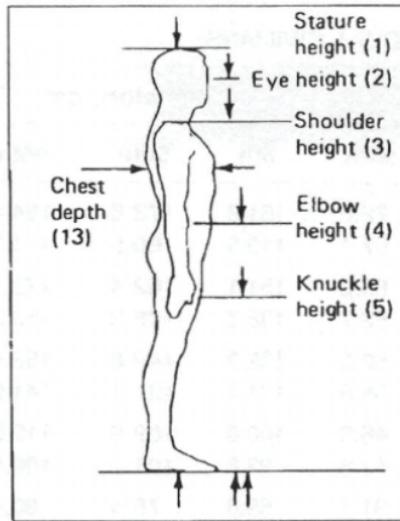


TABLE 13-1  
SELECTED BODY DIMENSIONS AND WEIGHTS OF U.S. ADULT CIVILIANS\*

Body dimension	Sex	Dimension, in			Dimension, cm		
		5th	50th	95th	5th	50th	95th
1. Stature (height)	Male	63.7	68.3	72.6	161.8	173.6	184.4
	Female	58.9	63.2	67.4	149.5	160.5	171.3
2. Eye height	Male	59.5	63.9	68.0	151.1	162.4	172.7
	Female	54.4	58.6	62.7	138.3	148.9	159.3
3. Shoulder height	Male	52.1	56.2	60.0	132.3	142.8	152.4
	Female	47.7	51.6	55.9	121.1	131.1	141.9
4. Elbow height	Male	39.4	43.3	46.9	100.0	109.9	119.0
	Female	36.9	39.8	42.8	93.6	101.2	108.8
5. Knuckle height	Male	27.5	29.7	31.7	69.8	75.4	80.4
	Female	25.3	27.6	29.9	64.3	70.2	75.9
6. Height, sitting	Male	33.1	35.7	38.1	84.2	90.6	96.7
	Female	30.9	33.5	35.7	78.6	85.0	90.7
7. Eye height, sitting	Male	28.6	30.9	33.2	72.6	78.6	84.4
	Female	26.6	28.9	30.9	67.5	73.3	78.5
8. Elbow rest height, sitting	Male	7.5	9.6	11.6	19.0	24.3	29.4
	Female	7.1	9.2	11.1	18.1	23.3	28.1
9. Thigh clearance height	Male	4.5	5.7	7.0	11.4	14.4	17.7
	Female	4.2	5.4	6.9	10.6	13.7	17.5
10. Knee height, sitting	Male	19.4	21.4	23.3	49.3	54.3	59.3
	Female	17.8	19.6	21.5	45.2	49.8	54.5
11. Buttock-knee distance, sitting	Male	21.3	23.4	25.3	54.0	59.4	64.2
	Female	20.4	22.4	24.6	51.8	56.9	62.5
12. Popliteal height, sitting	Male	15.4	17.4	19.2	39.2	44.2	48.8
	Female	14.0	15.7	17.4	35.5	39.8	44.3
13. Chest depth	Male	8.4	9.5	10.9	21.4	24.2	27.6
	Female	8.4	9.5	11.7	21.4	24.2	29.7
14. Elbow-elbow breadth	Male	13.8	16.4	19.9	35.0	41.7	50.6
	Female	12.4	15.1	19.3	31.5	38.4	49.1
15. Hip breadth, sitting	Male	12.1	13.9	16.0	30.8	35.4	40.6
	Female	12.3	14.3	17.2	31.2	36.4	43.7
X. Weight (lbs and kg)	Male	123.6	162.8	213.6	56.2	74.0	97.1
	Female	101.6	134.4	197.8	46.2	61.1	89.9

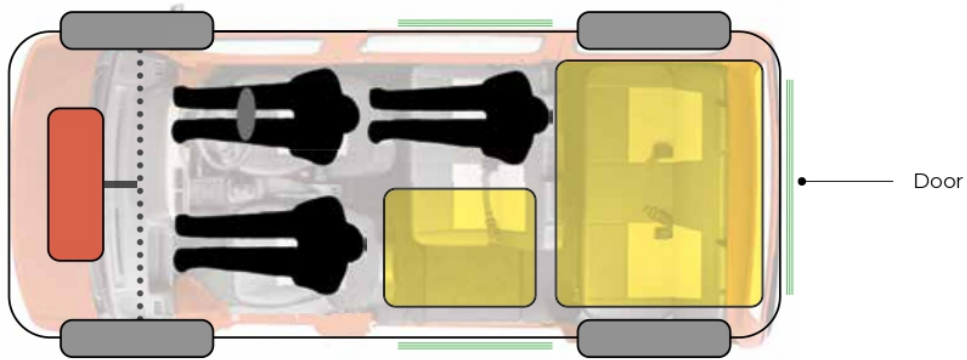
\* Body dimensions are depicted in Figure 13-1.  
Source: Kroemer, 1989. (Courtesy of Dr. J. T. McConville, Anthropology Research Project, Yellow Springs, OH 45387, and Dr. K. W. Kennedy, USAF-AMRL-HEG, OH 45433.)

Source: Human Factors In Engineering And Design / Mark S. Sanders, Ernest McCormick. -7th ed.

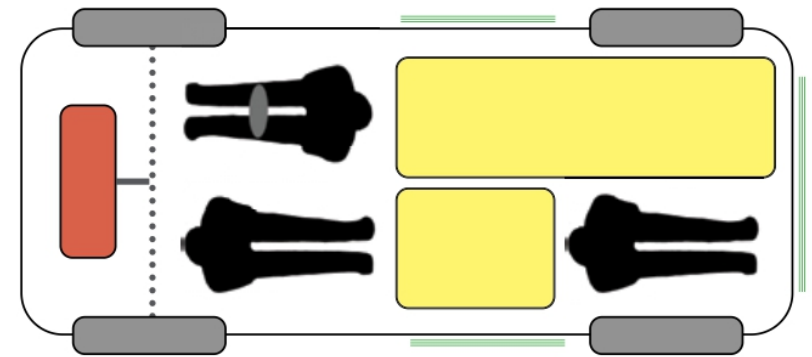
## 6.5 LAYOUT CONCEPTS

Having Cargo and 3 Persons with one driver and 2 postmen in the various seating layout and cargo space designed around specific objects.

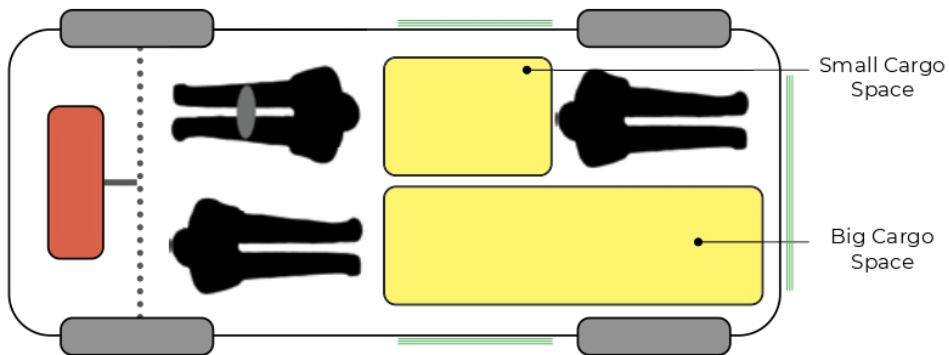
Layout 1



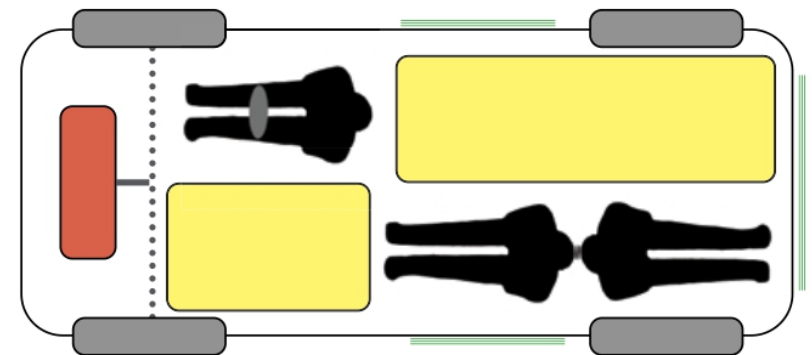
Layout 2



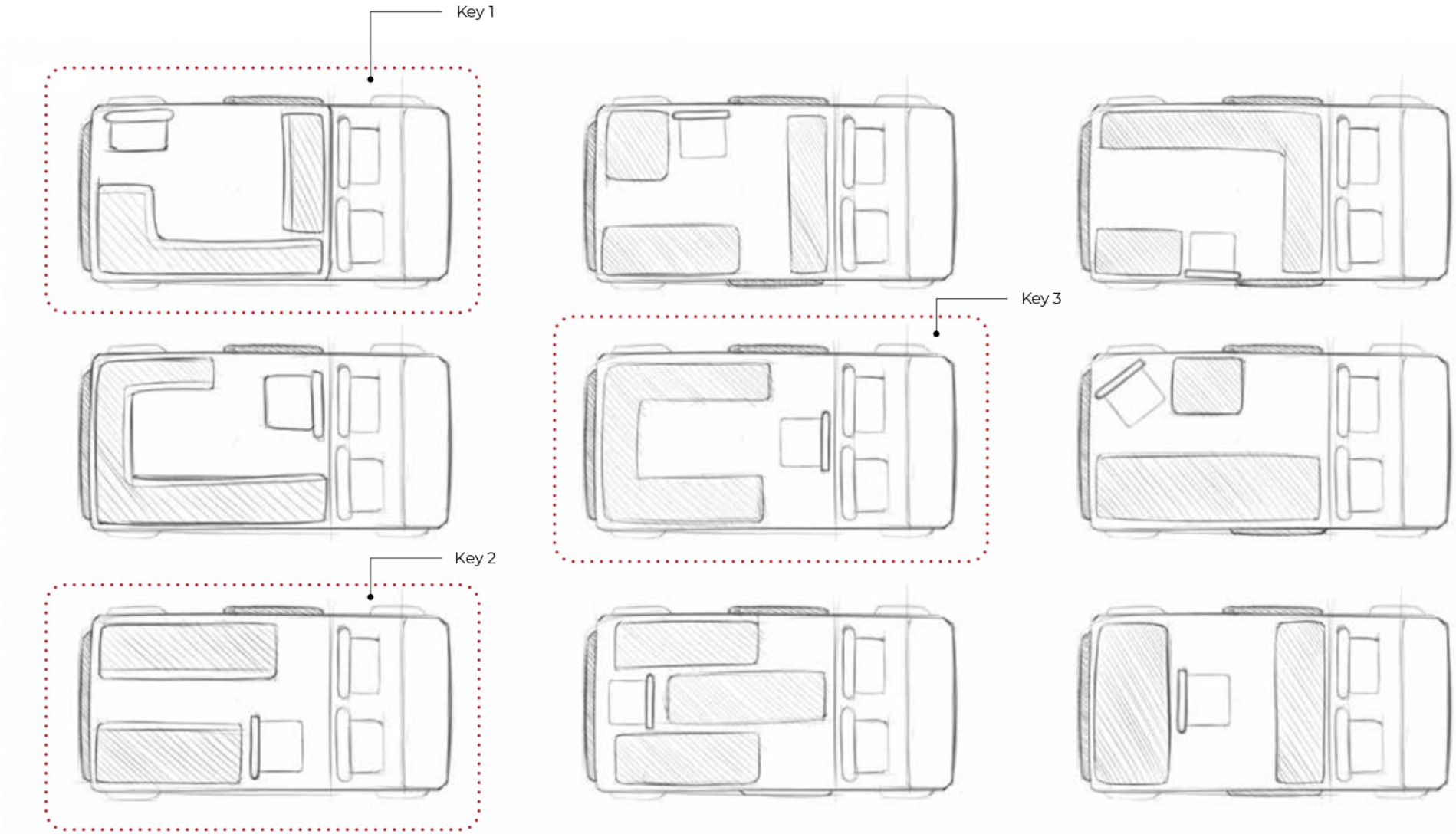
Layout 3



Layout 4

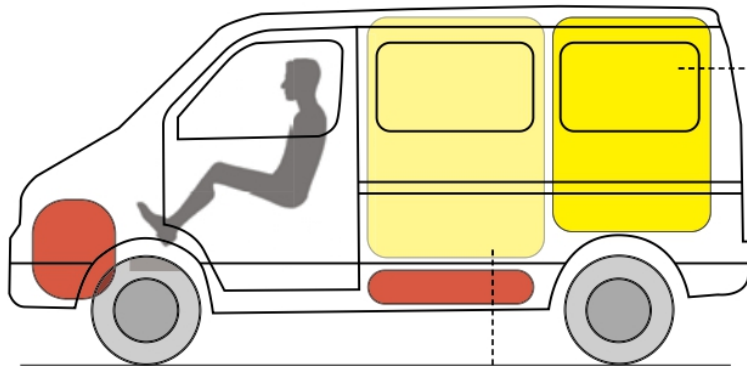


# Layout Ideations

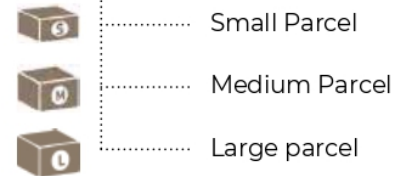


## 6.6 CARGO STORAGE VOLUME

The Postman will dictate the type of parcel/cargo postman will carry and here are dimensions & weight of parcels.



### Big Cargo Space

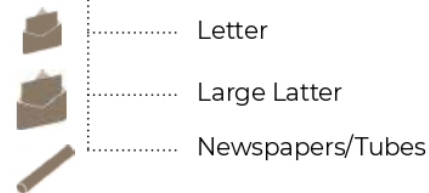


Max Weight	Max Length	Max Width	Max Thickness
2kg	45cm	35cm	16cm
20kg	61cm	46cm	46cm
30kg	1.5m	1m	3m

### Small Parcel Space

	Max Weight
Letter or greeting card	30g
Glossy magazine in bubble envelope	585g
A4 envelope with 20 sheets of A4	160g
4 sheets of papers	44g
Certificates papers	30g

### Small Cargo Space



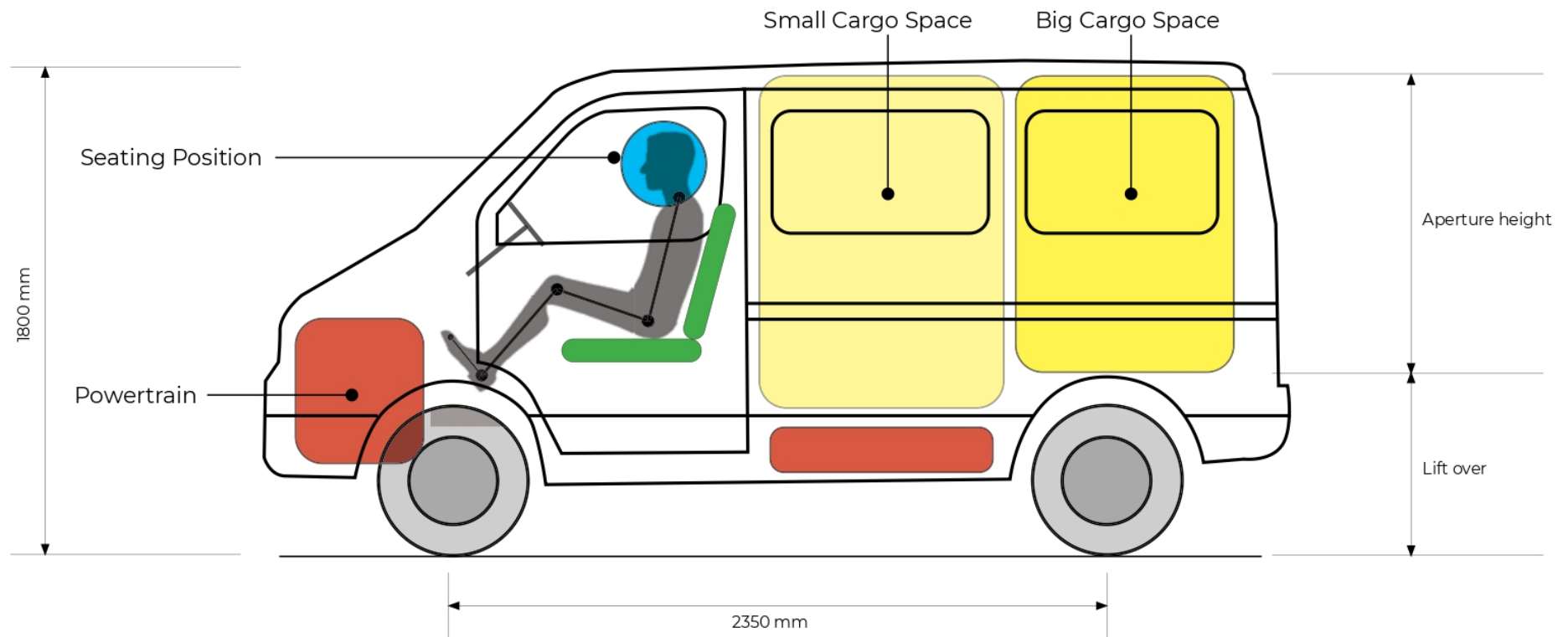
Max Weight	Max Length	Max Width	Max Thickness
100g	24cm	16.5cm	5mm
750g	35.5cm	25cm	2.5cm
2kg	50cm	Diameter: 104cm	

All parcels come in all shapes and sizes.



## 6.7 PACKAGE IDEATION PROCESS

Package Concepts based on functional objectives include layout of the cargo, powertrain, wheel and fuel.



# Vehicle Powertrain Technologies

The powertrain is a complex system that refers to everything in the vehicle that makes it move, including the engine, transmission, and components that allow the power to travel from the engine to the wheels. Here's a simple explanation of how it works and The type of powertrain the vehicle has determines which wheels turn.

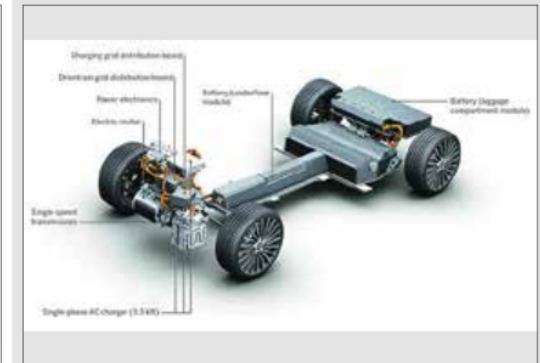
## Internal combustion engine Vehicles (ICEs)



## Battery electric vehicles (BEVs)



## Hybrid Electric Vehicles (HEVs)



### Parameters

#### Fuel Efficiency

ICE

Battery

Mix of ICE and Battery

#### Fuel Source

Petrol and Diesel

Battery Pack

Electricity and Fossil Fuel

#### Engine

ICE

Electric Motor

ICE and Electric Motor

#### Price Range

Normal

High

Similar to ICE Cars

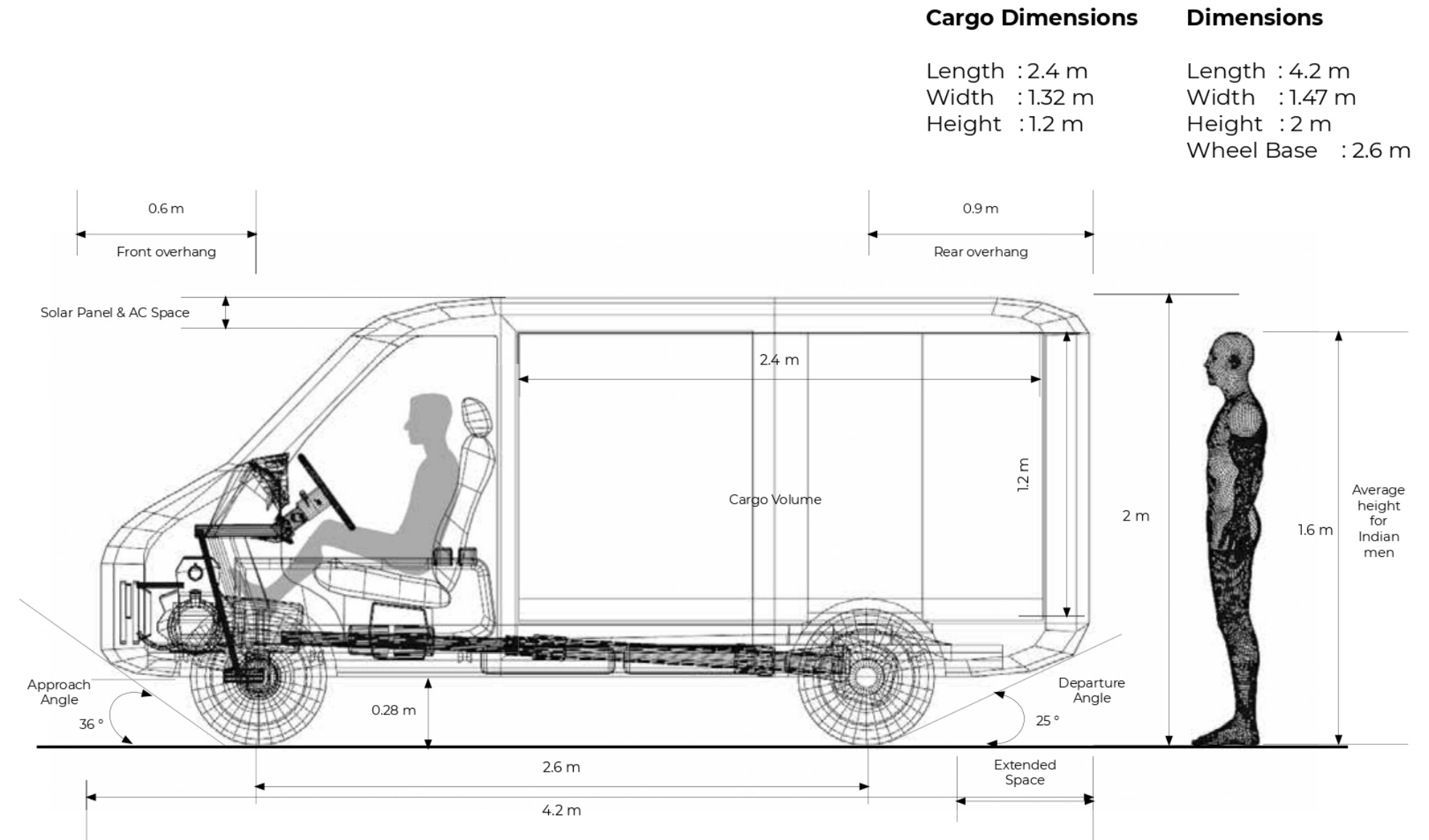
#### Charging

NA

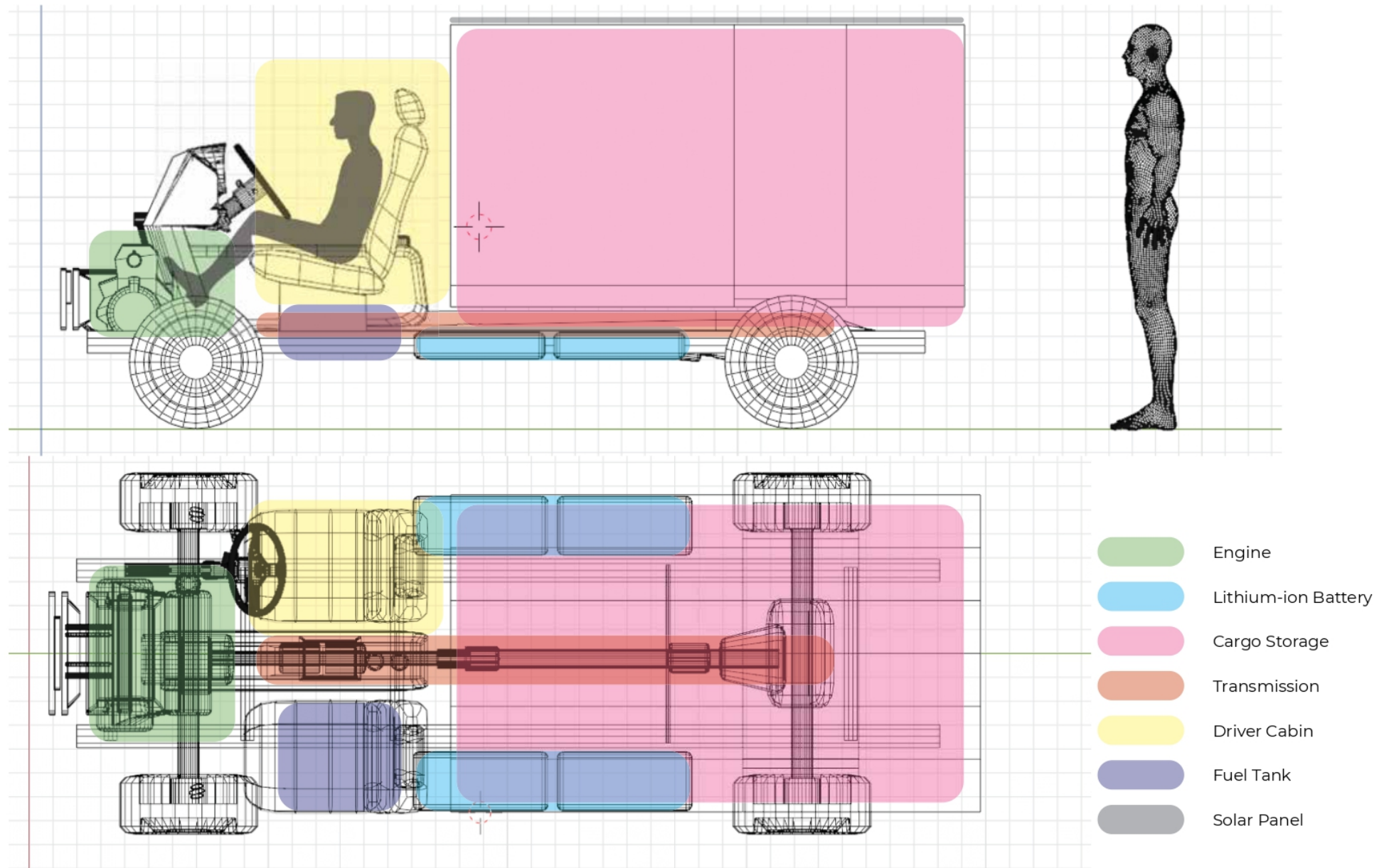
Needed

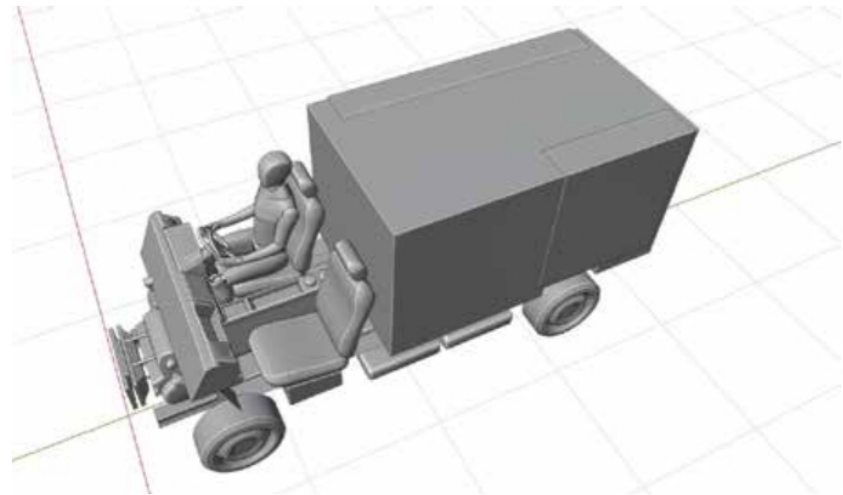
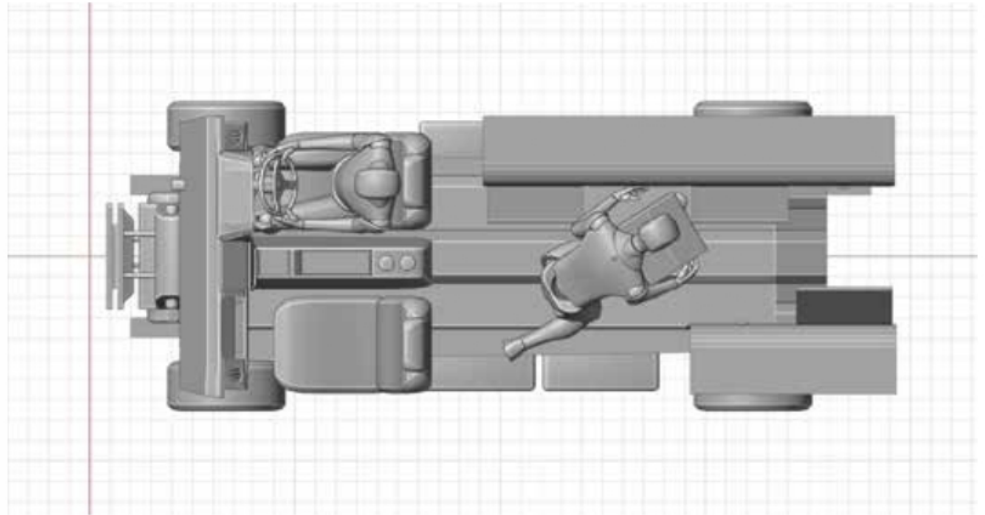
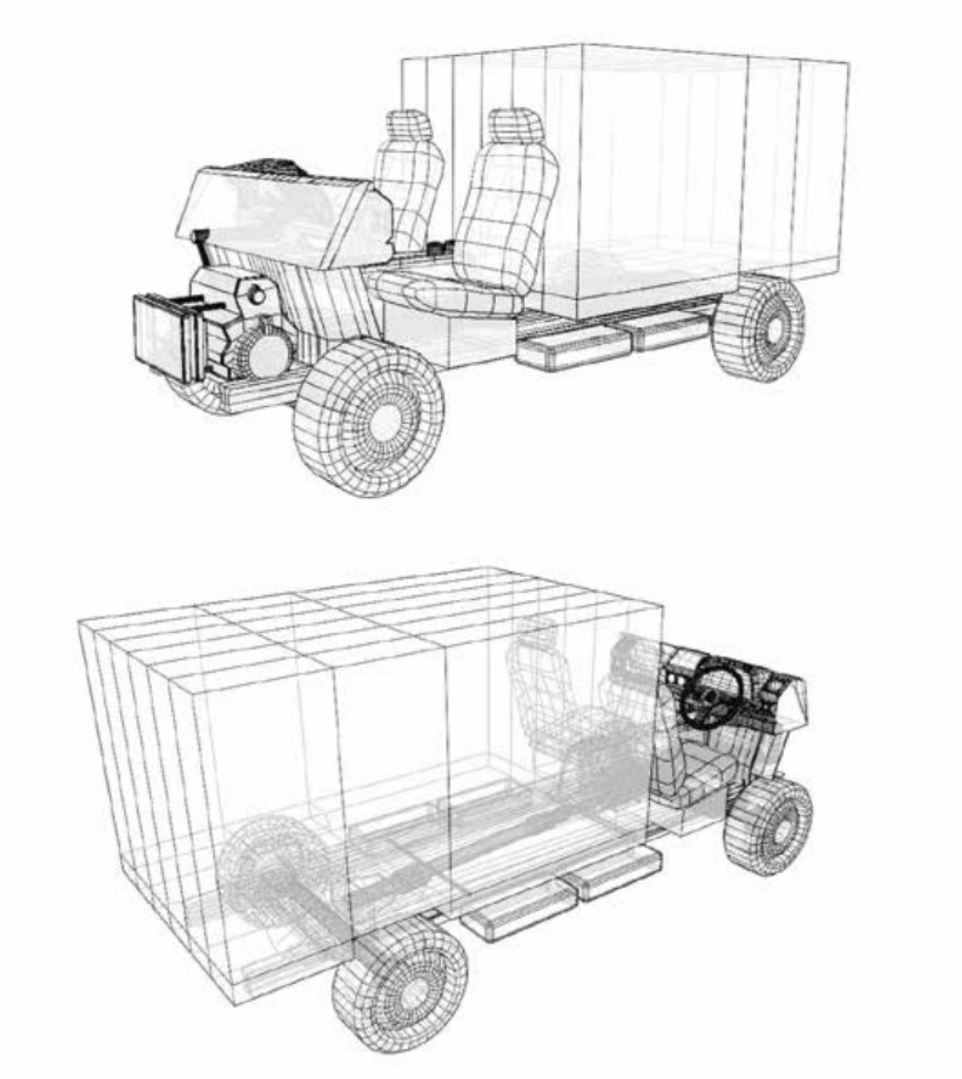
Not Needed

## 6.8 FINAL TECHNICAL PACKAGE DIMENSIONS WITH EXTERIOR

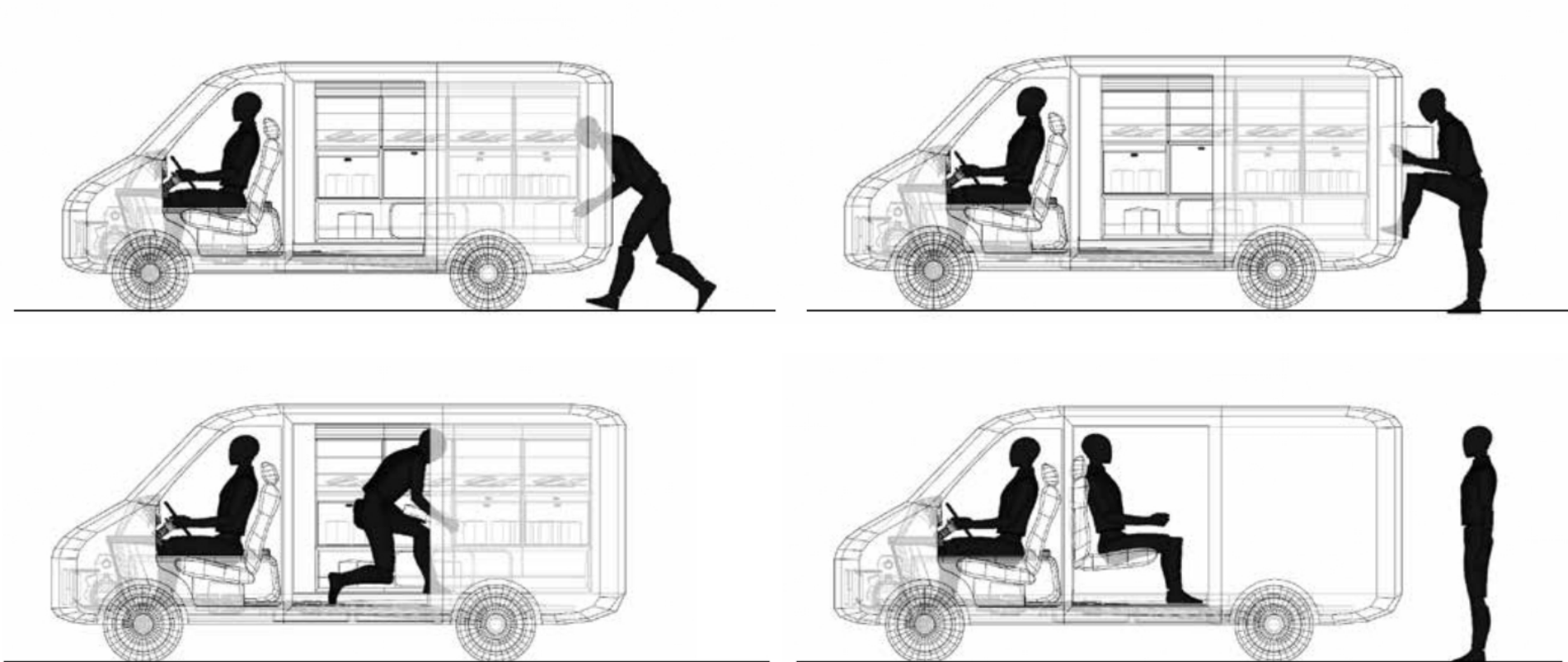


## Final 3D CAD Technical Package (side elevation)

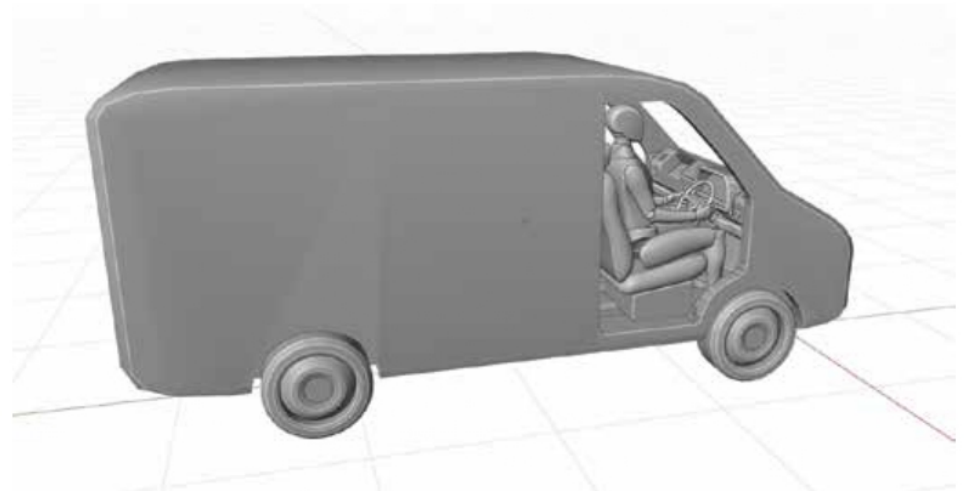
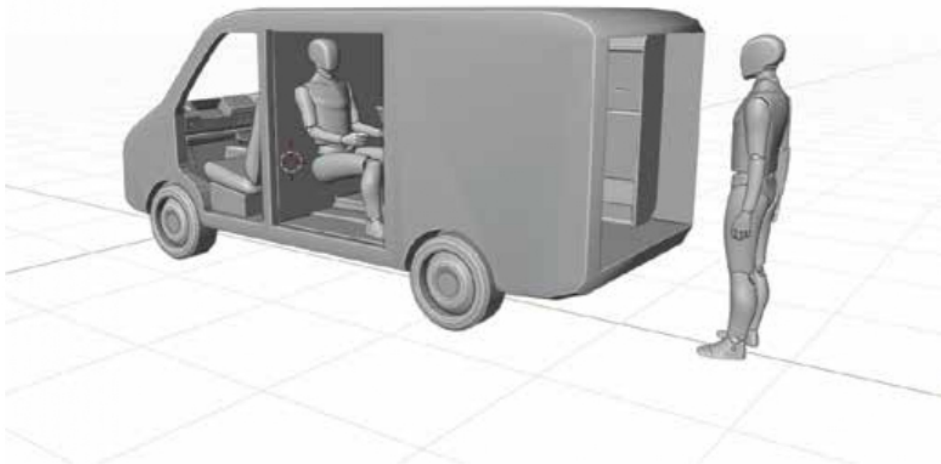
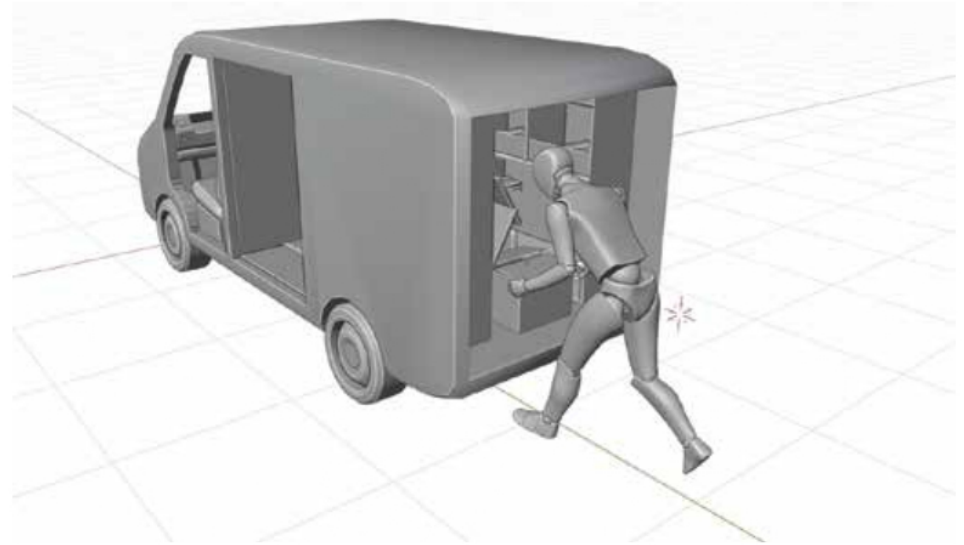
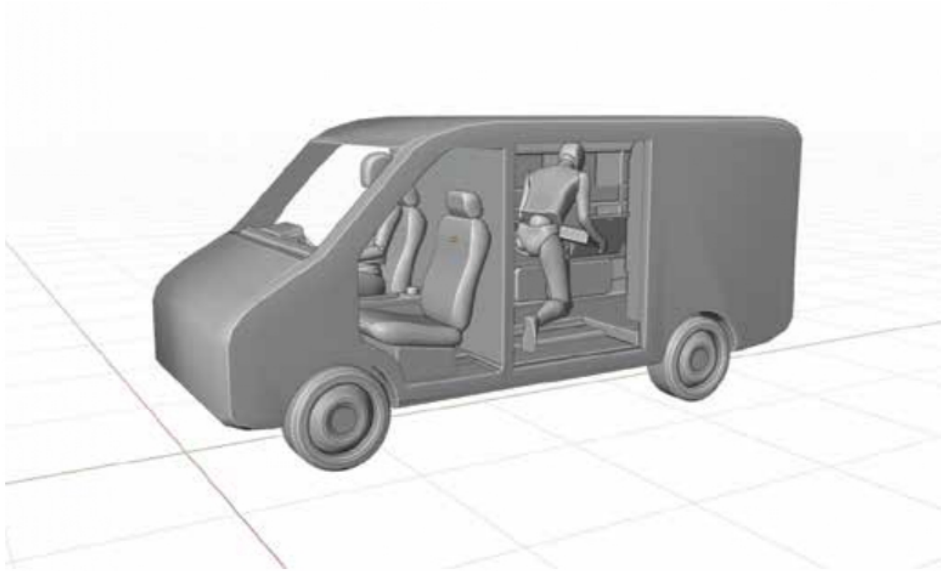




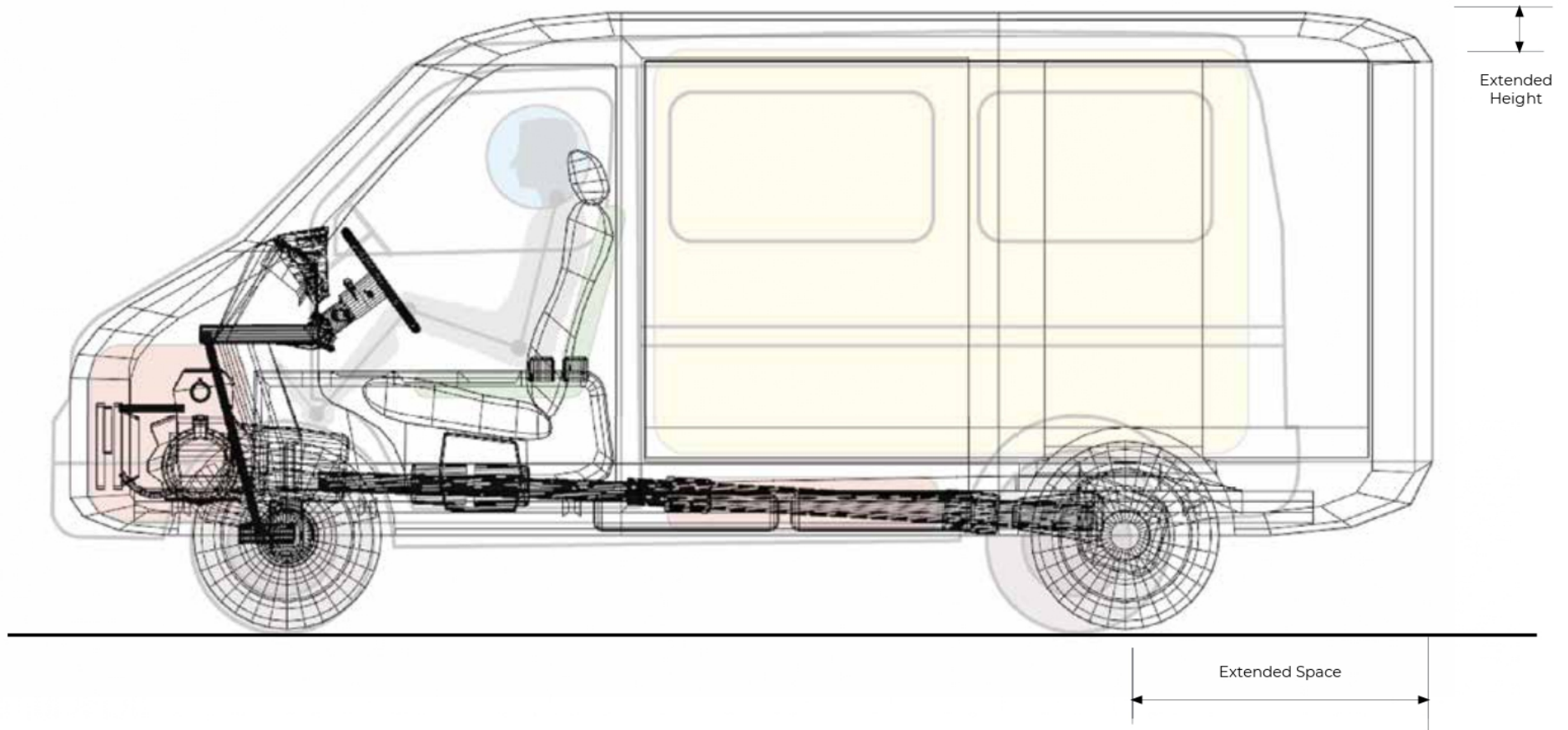
## 6.9 INTERIOR ERGONOMICS PACKAGE



## Interior Ergonomics 3D CAD Package



## Comparison with current Mini-van VS final package





## 7. DESIGN CONCEPT

Between Stage 1 and 2, Based on the inputs from the research, several directions had been explored during the ideation phase. These directions have come out from the need of the user and their ability to use the vehicle as a commercial mode of transport.

Most of the ideas were developed during the ideation sketches and packaging sketches in stage 2. The final concept was selected after the getting concept of evolution of both interior and exterior design. Also, keywords were taken from research for both interior and exterior design using Moodboard.

## 7.1 INTERIOR DESIGN MOODBOARD



**MINIMAL**

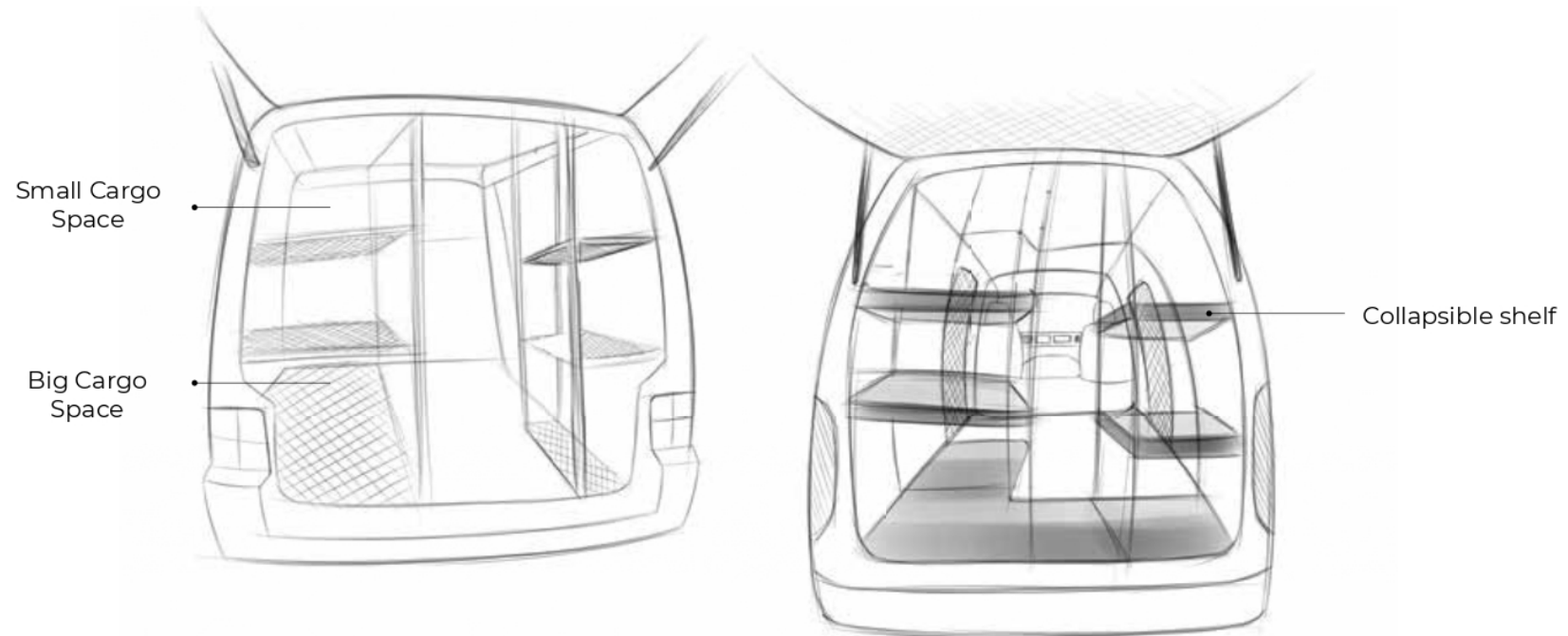
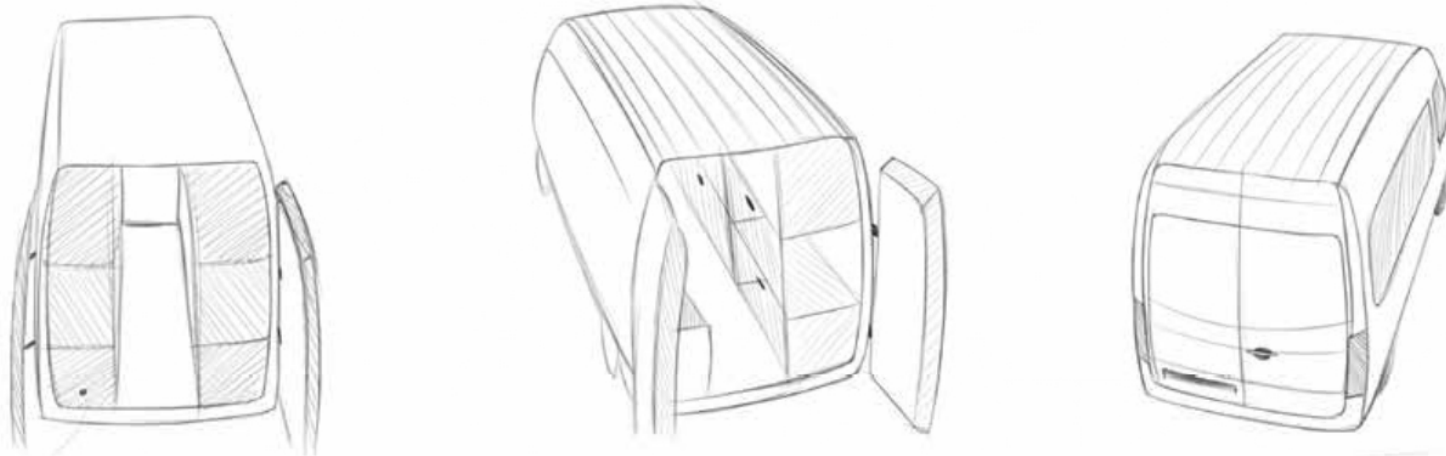


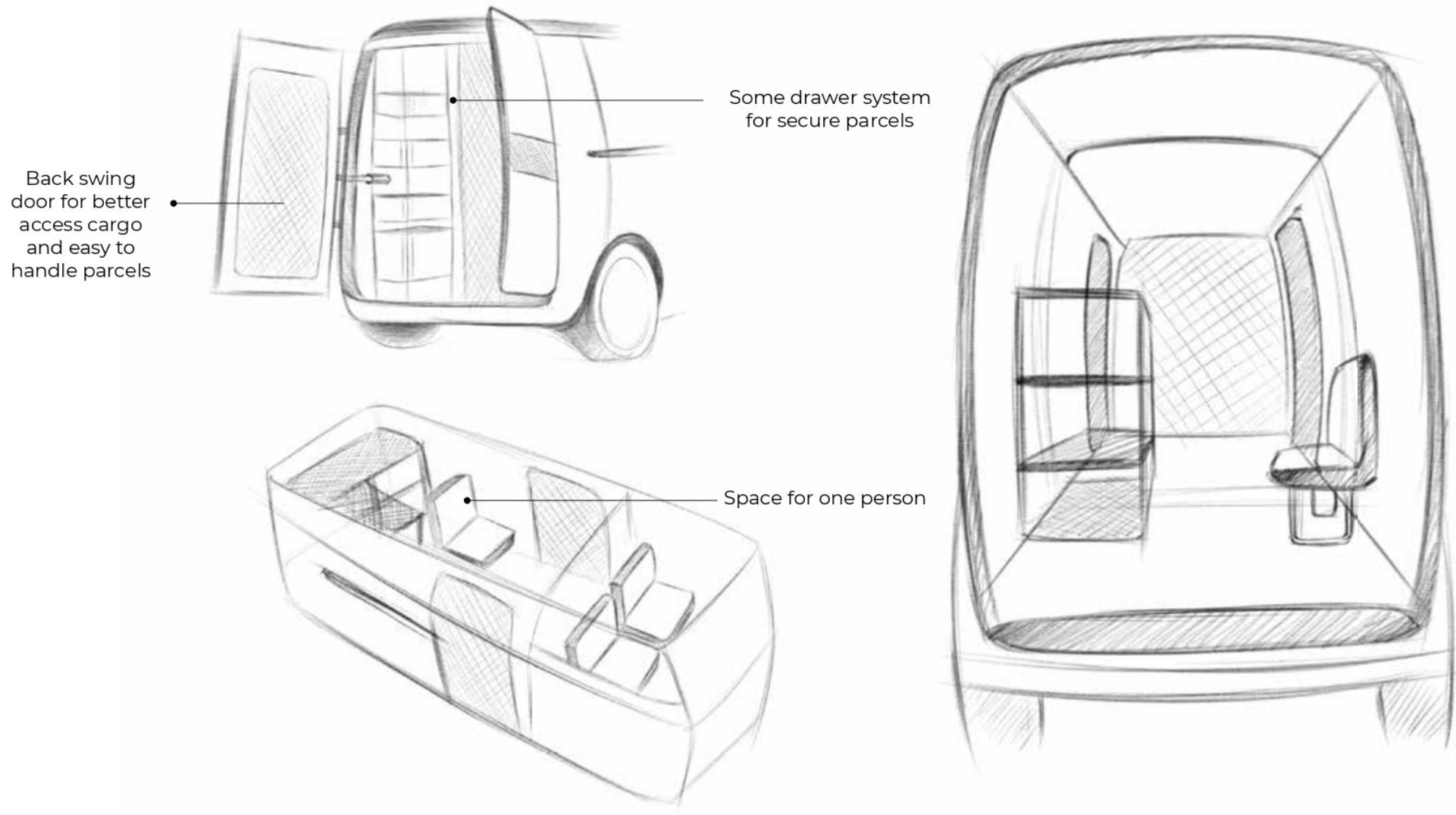
**SMART**

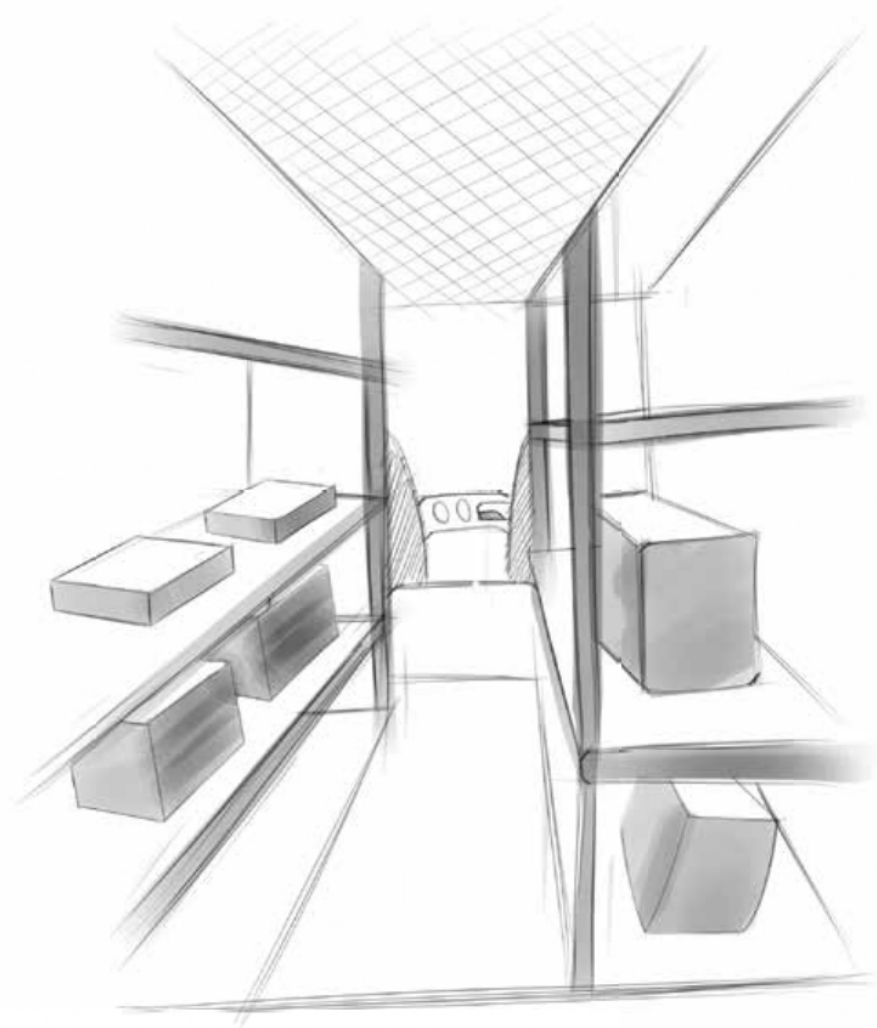


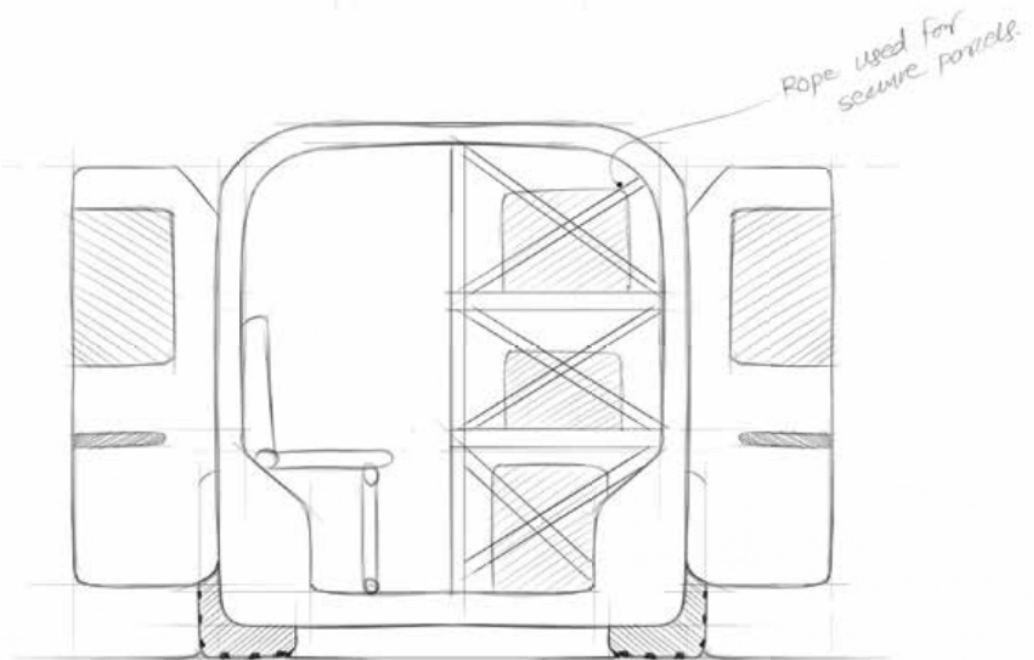
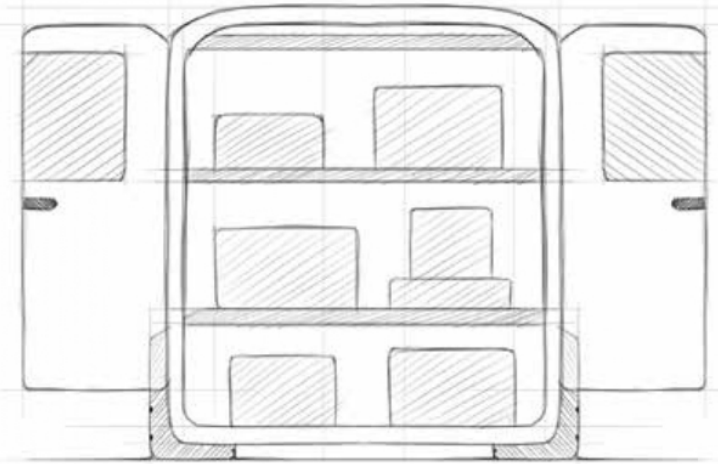
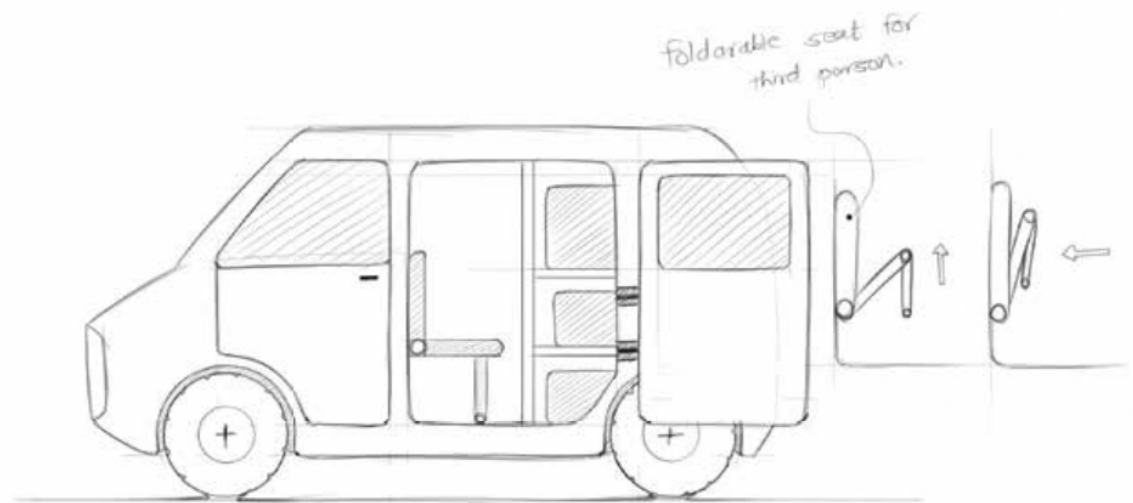
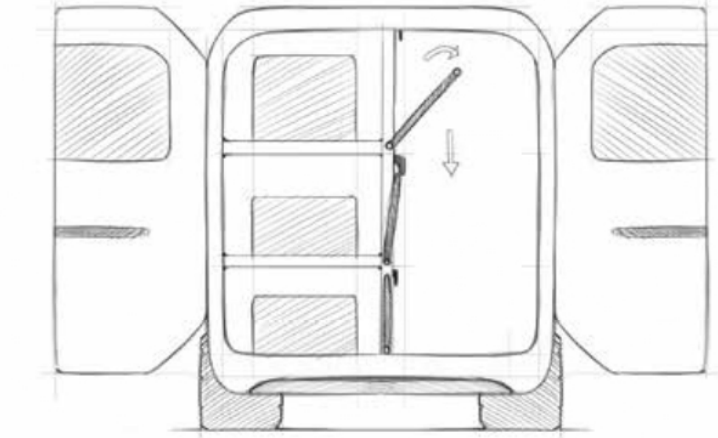
**USABILITY**

## 7.2 INTERIOR CARGO LAYOUT SKETCHES



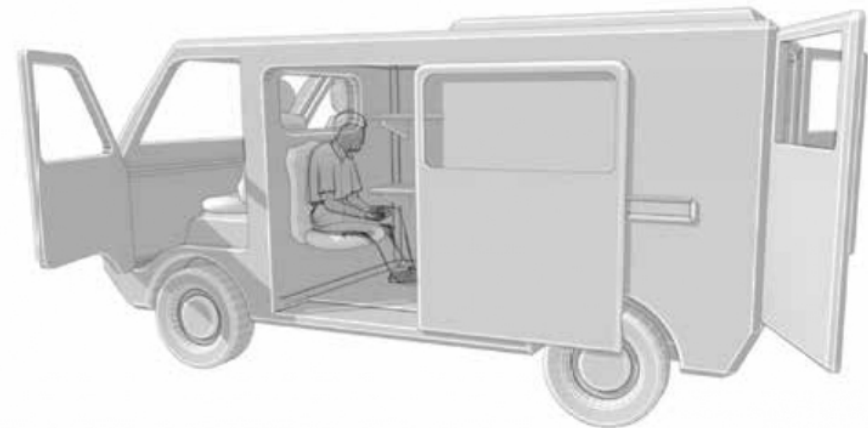
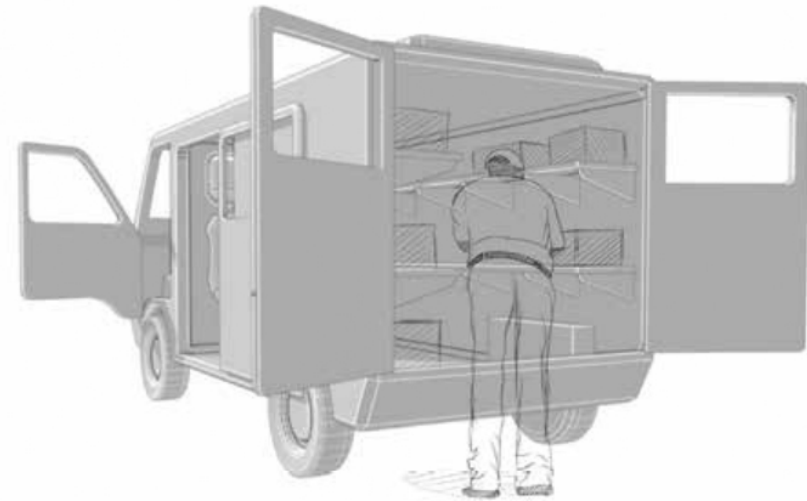
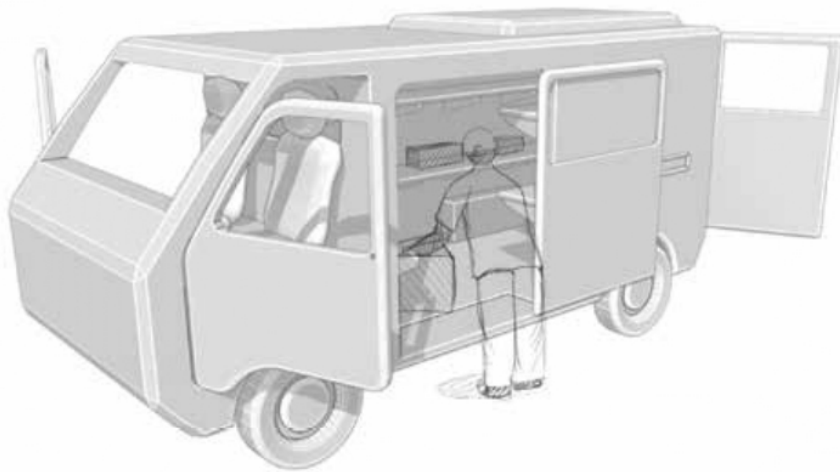


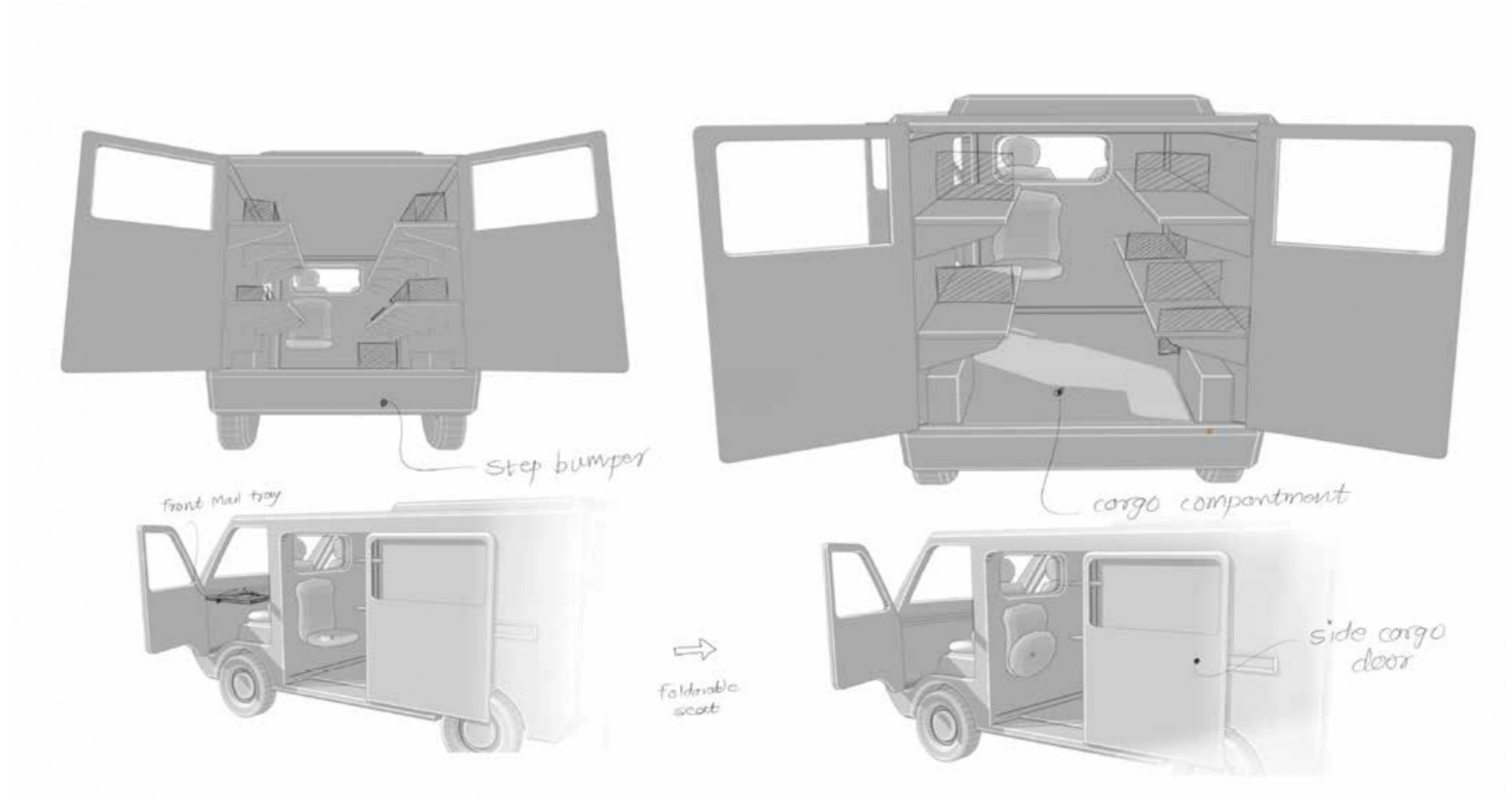




## 7.3 INTERIOR DESIGN CONCEPT (CAD MODEL)

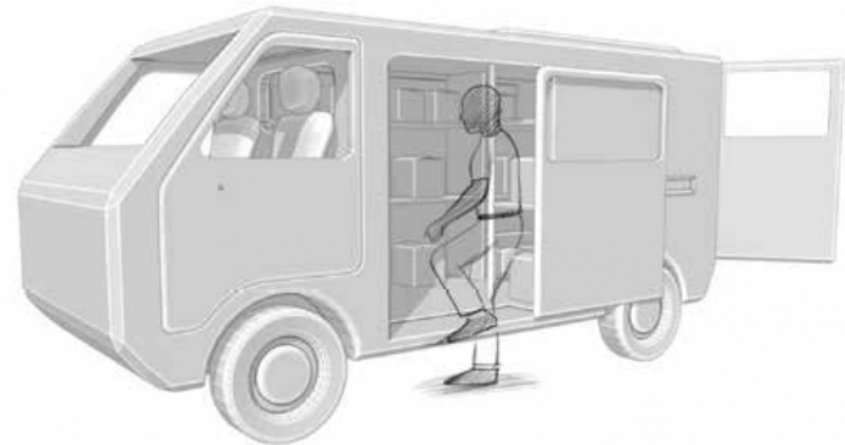
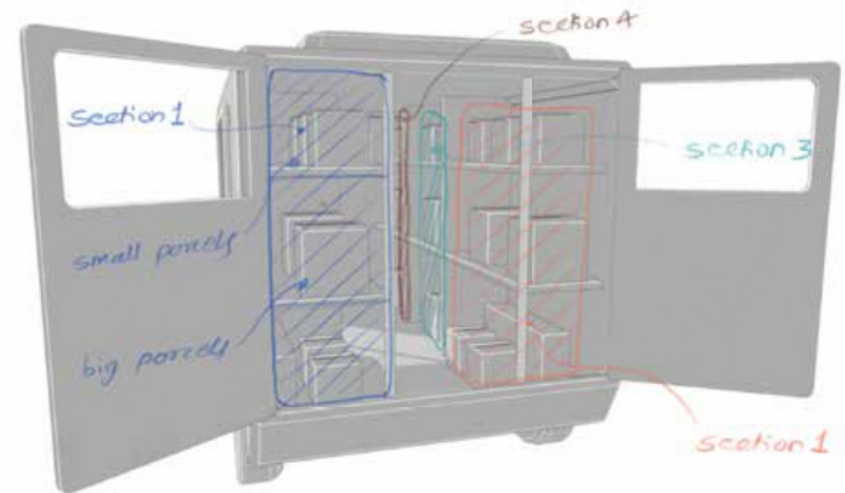
### Interior Design Concept 1

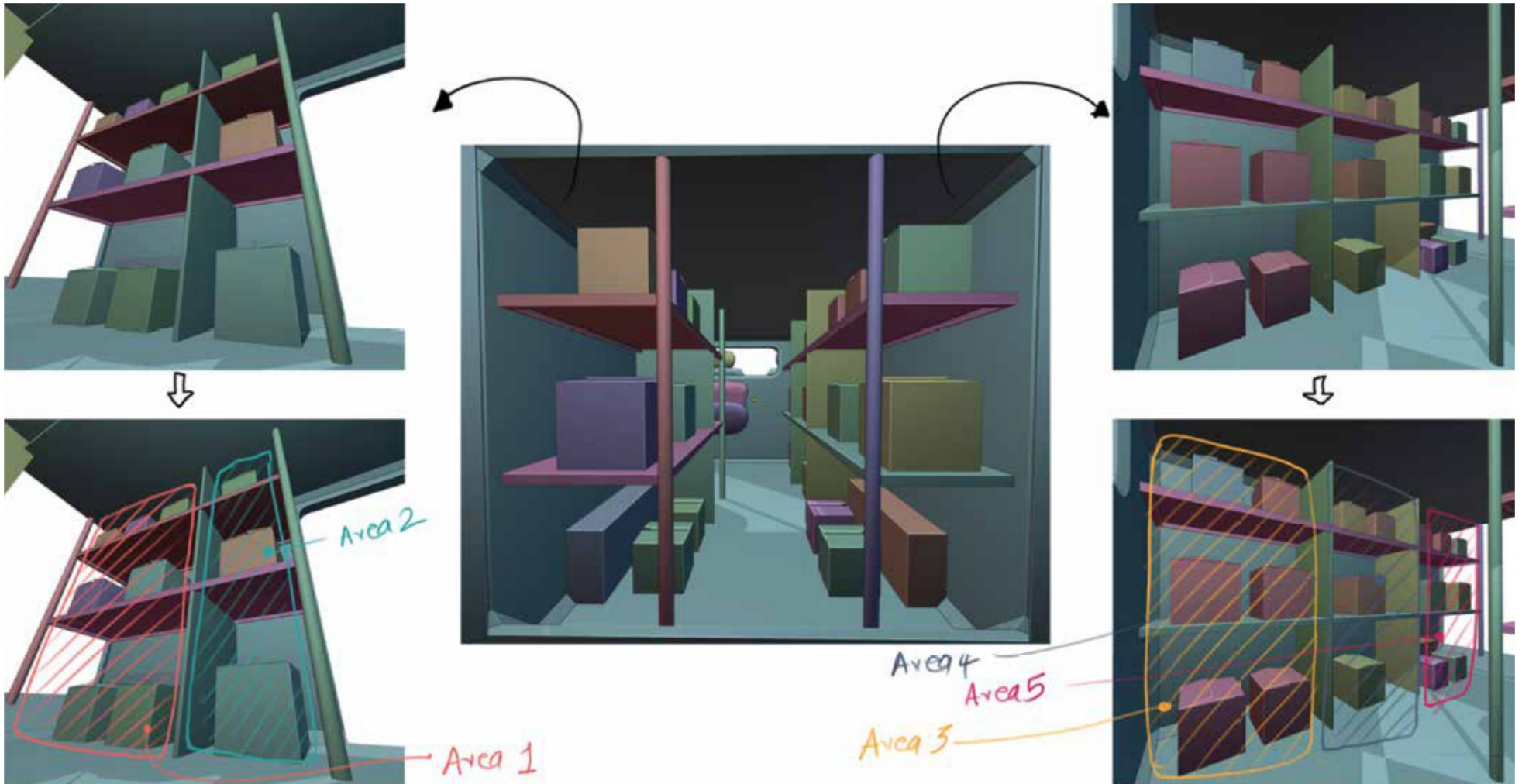




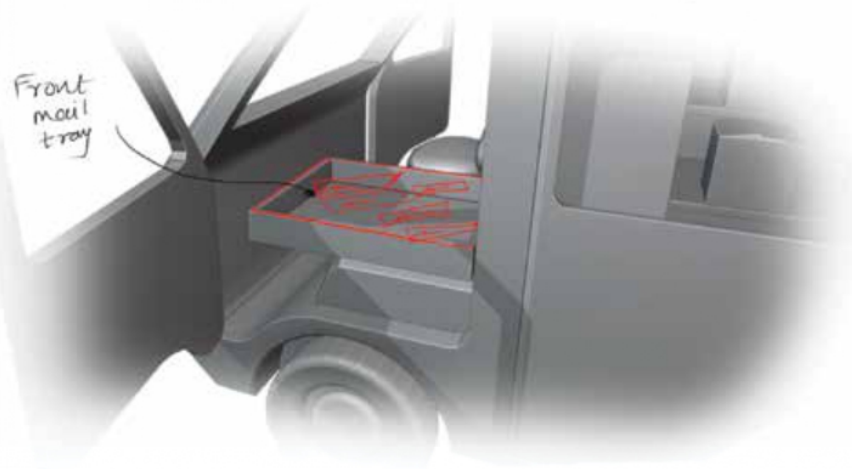
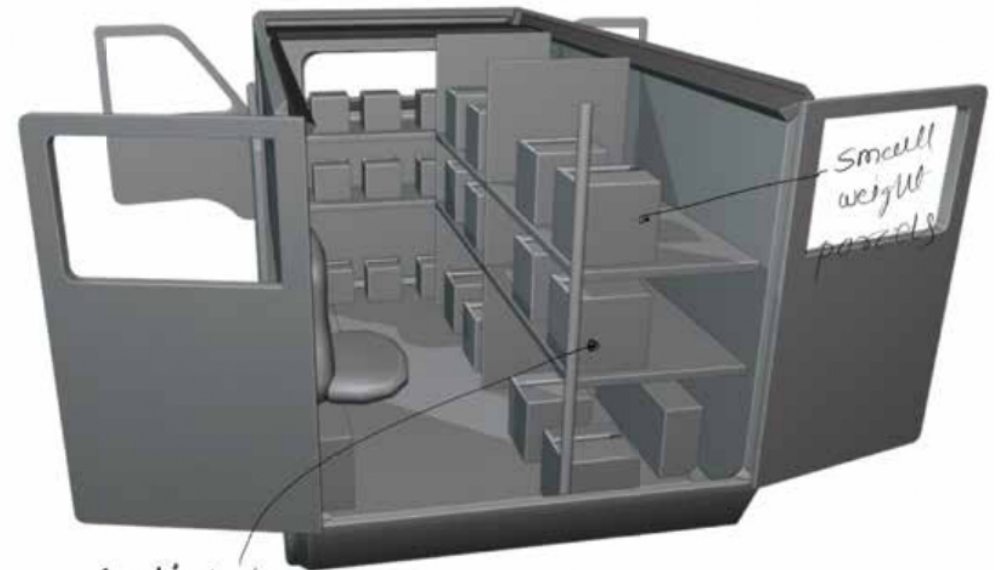


## Interior Design Concept 2



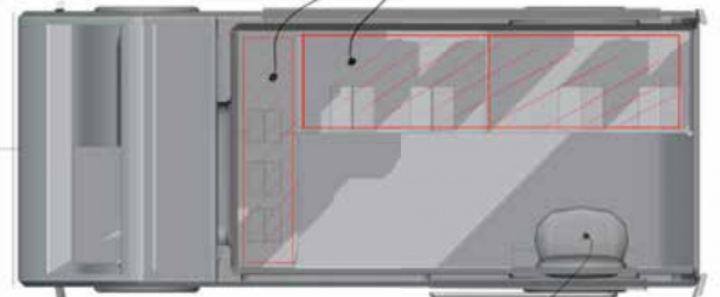


### Interior Design Concept 3

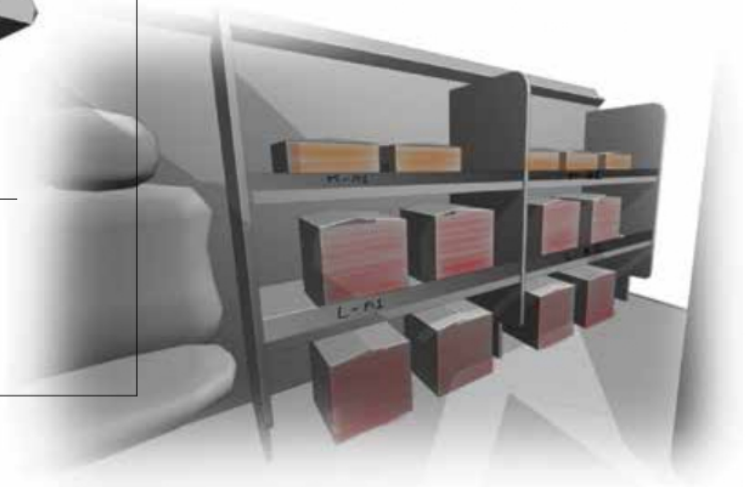
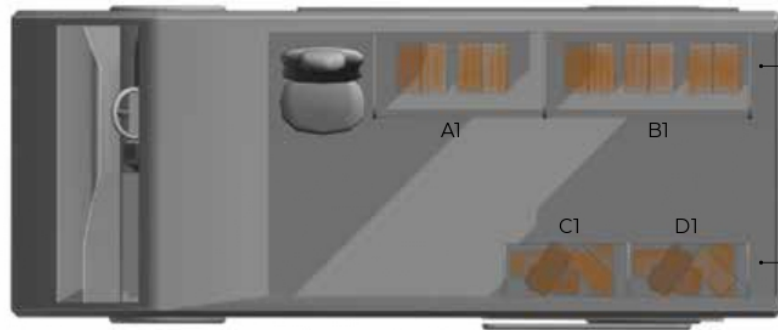
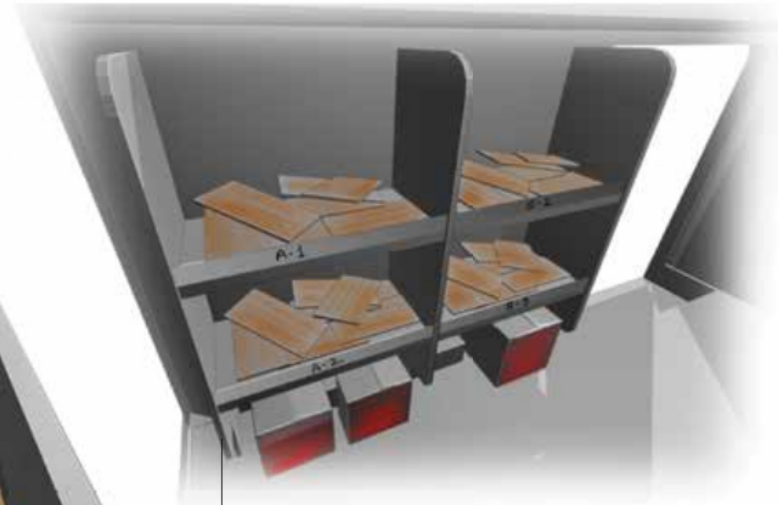


Medium size parcels / big parcels.

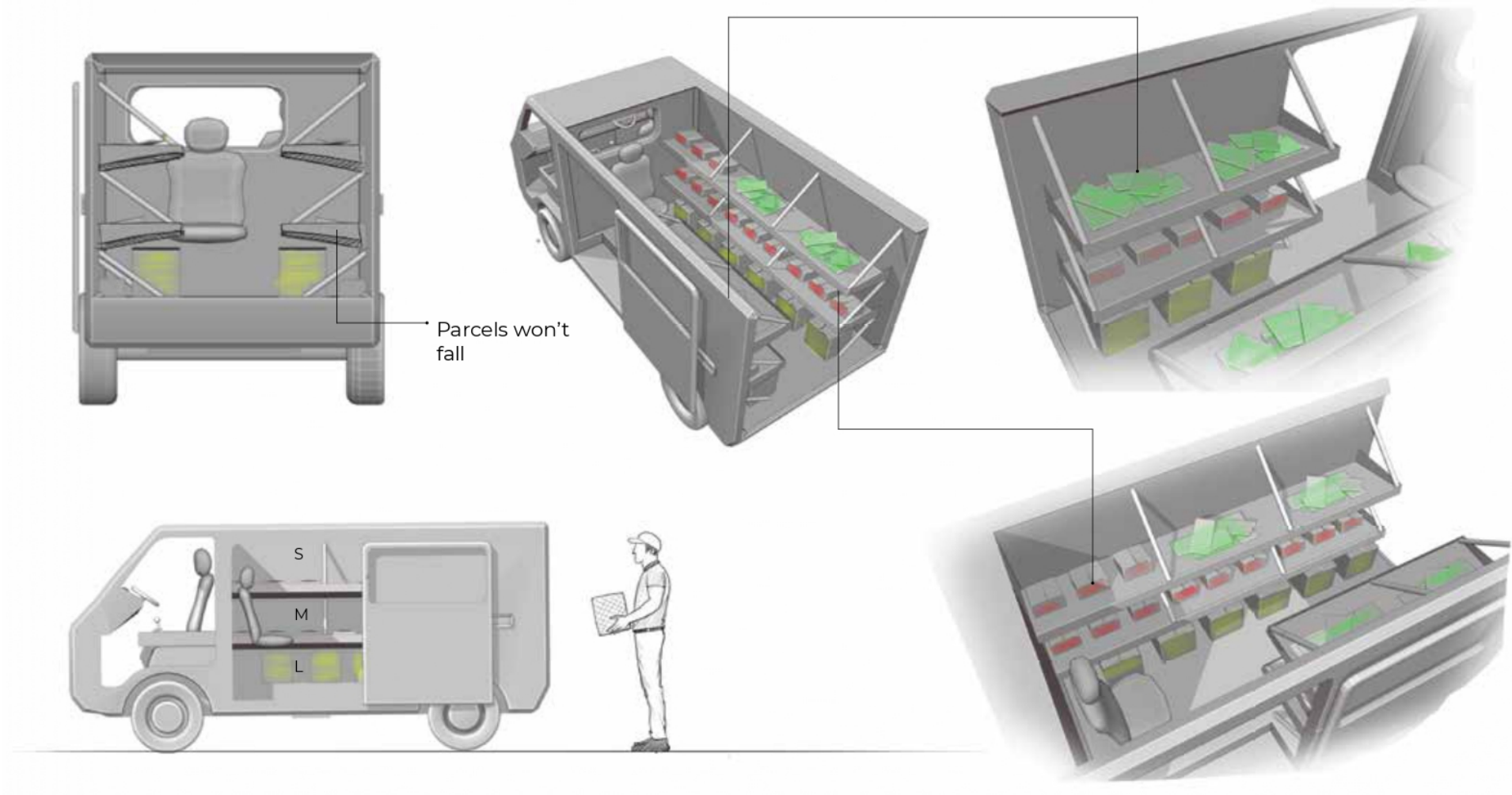
organization cargo space



# Interior Design Concept 4

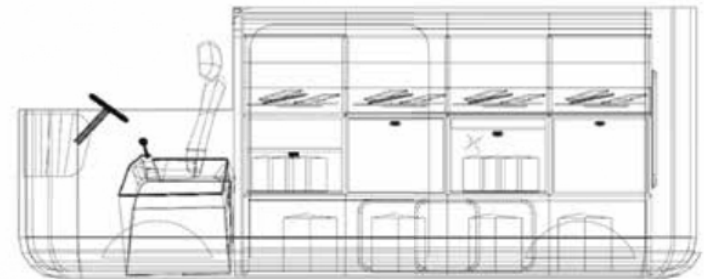
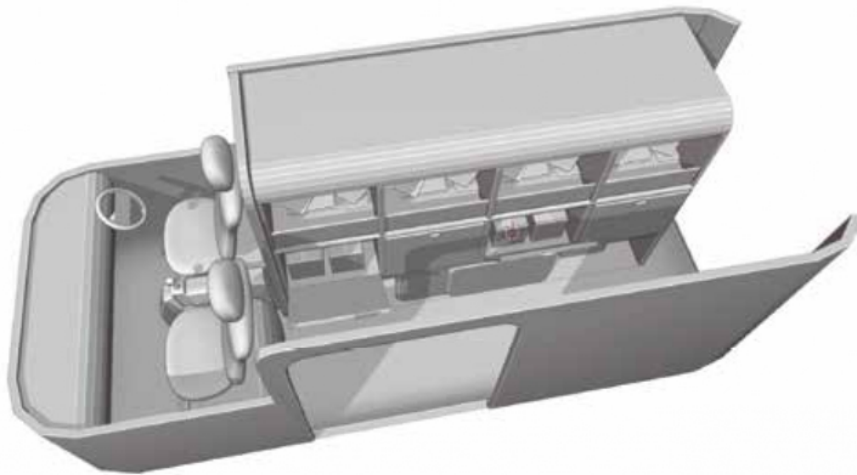
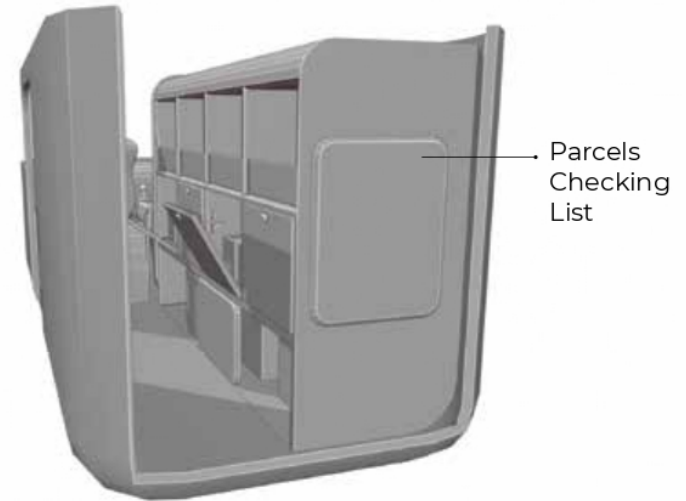
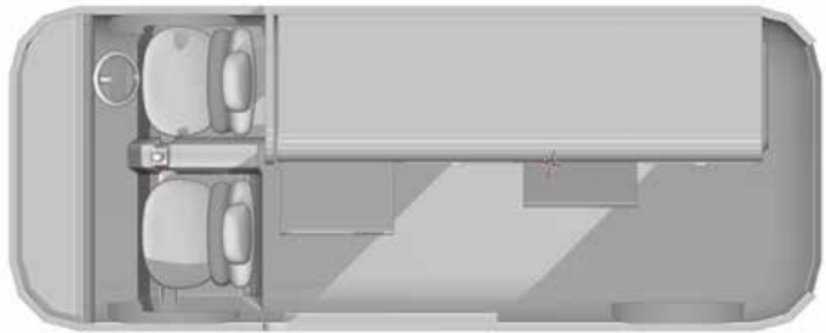


# Interior Design Concept 5



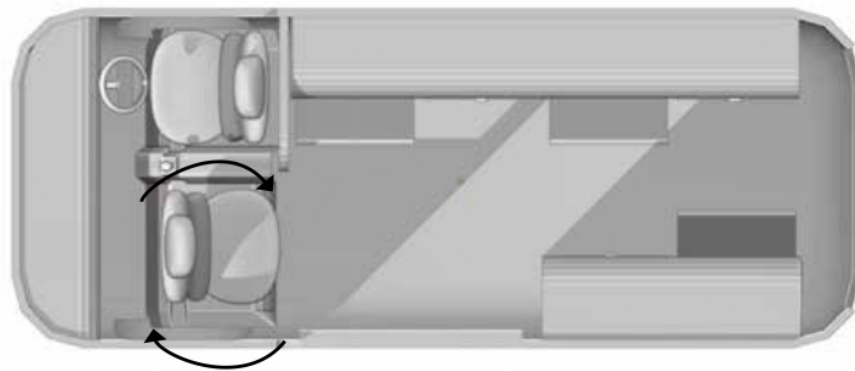
## Interior Design-A

Concept A idea is to show the organization of cargo storage for different sizes of parcels according to the requirements of the job of the postman. Also having a checklist for checking parcels and delivery to the area.

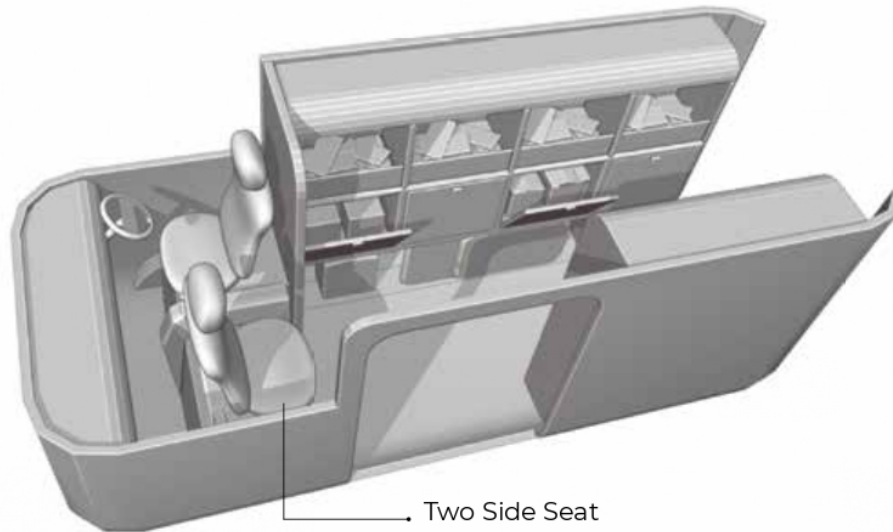
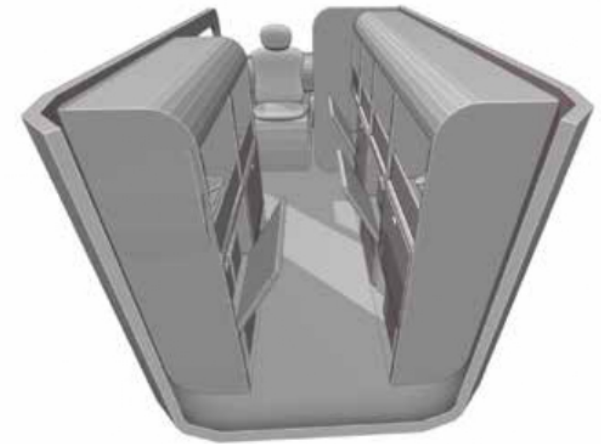


## Interior Design-B

Concept B idea is to show the organization of cargo storage for different sizes of parcels is in the both side and there have a rotating seat the person can seat either front and rear direction.



Rotating Seat

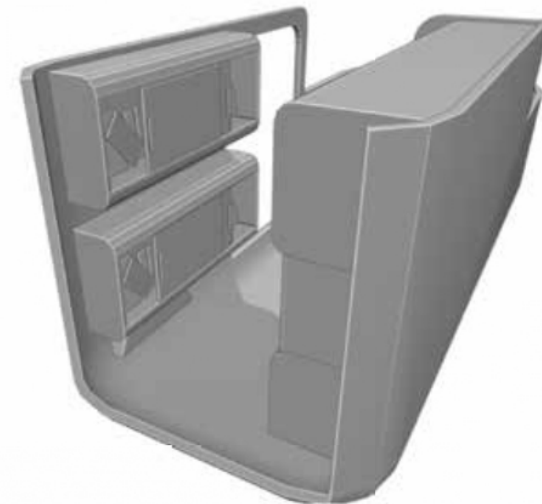
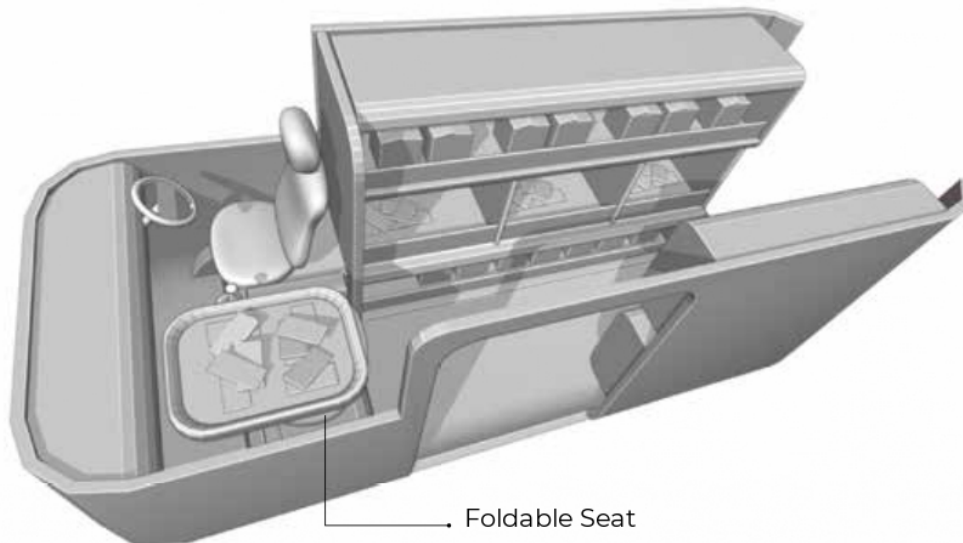
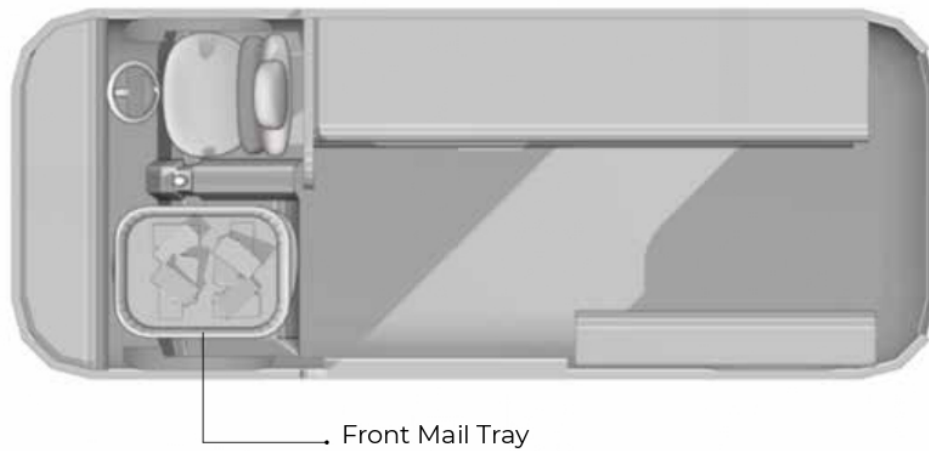


Two Side Seat



## Interior Design-C

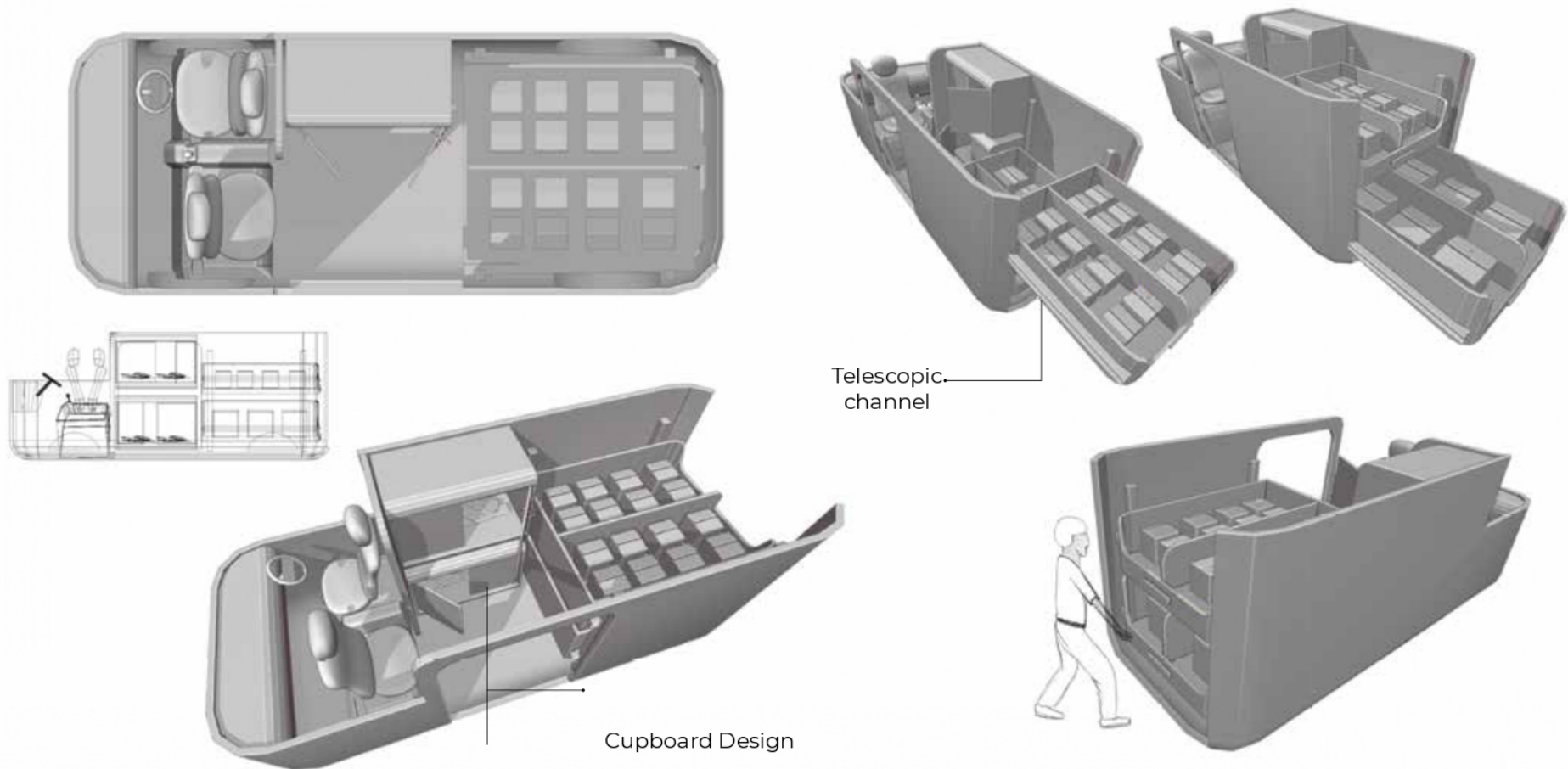
Concept C idea is to show the front seat passenger seat also used for storing the parcels for short distance commute and this seat is also foldable.













## Interior Design-D

Concept D idea is to show the organization of cargo storage can move out with using of the telescopic channel and this storage can push-pull in the rear direction. Postman can get easy access parcels. Also having a small cupboard for storing small parcels near the driver seat.



## 7.4 CONCEPT EVOLUTION OF INTERIOR DESIGN

	 	 	 	 
<b>Parameters</b>	Concept A	Concept B	Concept C	Concept D
<b>Configuration</b>	Right Side Cargo Compartment	Both Side Cargo Compartment	Both Side Cargo Compartment	Rear and Right Side Cargo Compartment
<b>Storage</b>	Upper to bottom - S M L Size Easy to Accessible	Upper to bottom - S M L Size Easy to finding Parcels.	Upper to bottom - M M L Size Easy to Accessible	Upper to bottom - M L S Size Pull push Storage
<b>Features</b>	Cabinet Door, Organization Storage	Cabinet Door, Organization Storage	Slide Door, Organization Storage	Organization Storage, Cupboard Storage
<b>Aesthetics</b>	Extreme	Volumetric	Minimal	Complex
<b>Seating Capacity</b>	2 Seats on the front Seat	1 Seat on the front Seat and other seat can be adjustable on both side	1 Seat on the front Seat and other seat can be foldable for storage	1 Seat on the front Seat and other seat can be adjustable on both side
<b>Doors</b>	Front Door, Sliding and Rear Swing door,	Front Door, Sliding and Rear Swing door,	Front Door, Sliding and Rear Swing door,	Front Door, Sliding and Rear Swing door,

## 7.5 EXTERIOR DESIGN MOODBOARD



**Accessible**



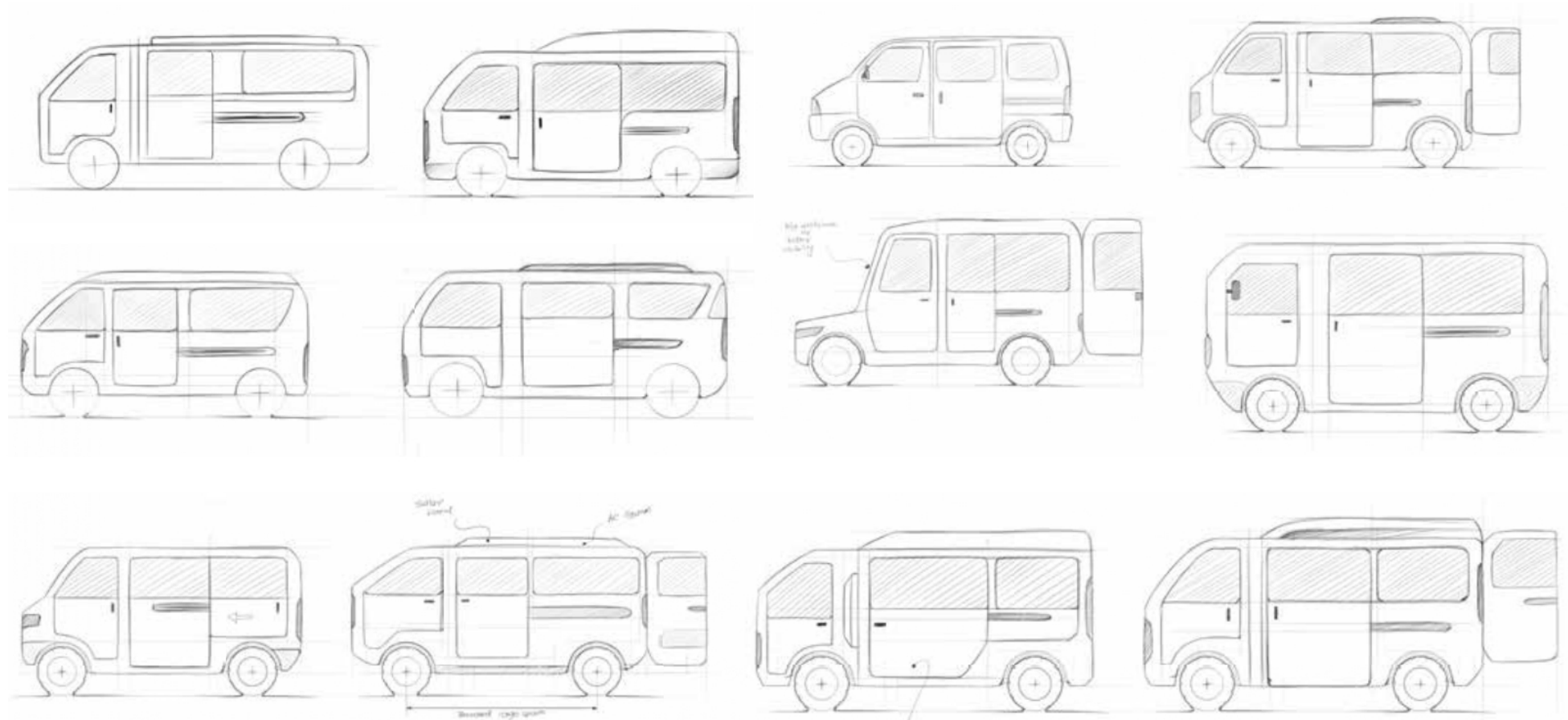
**Voluminous**



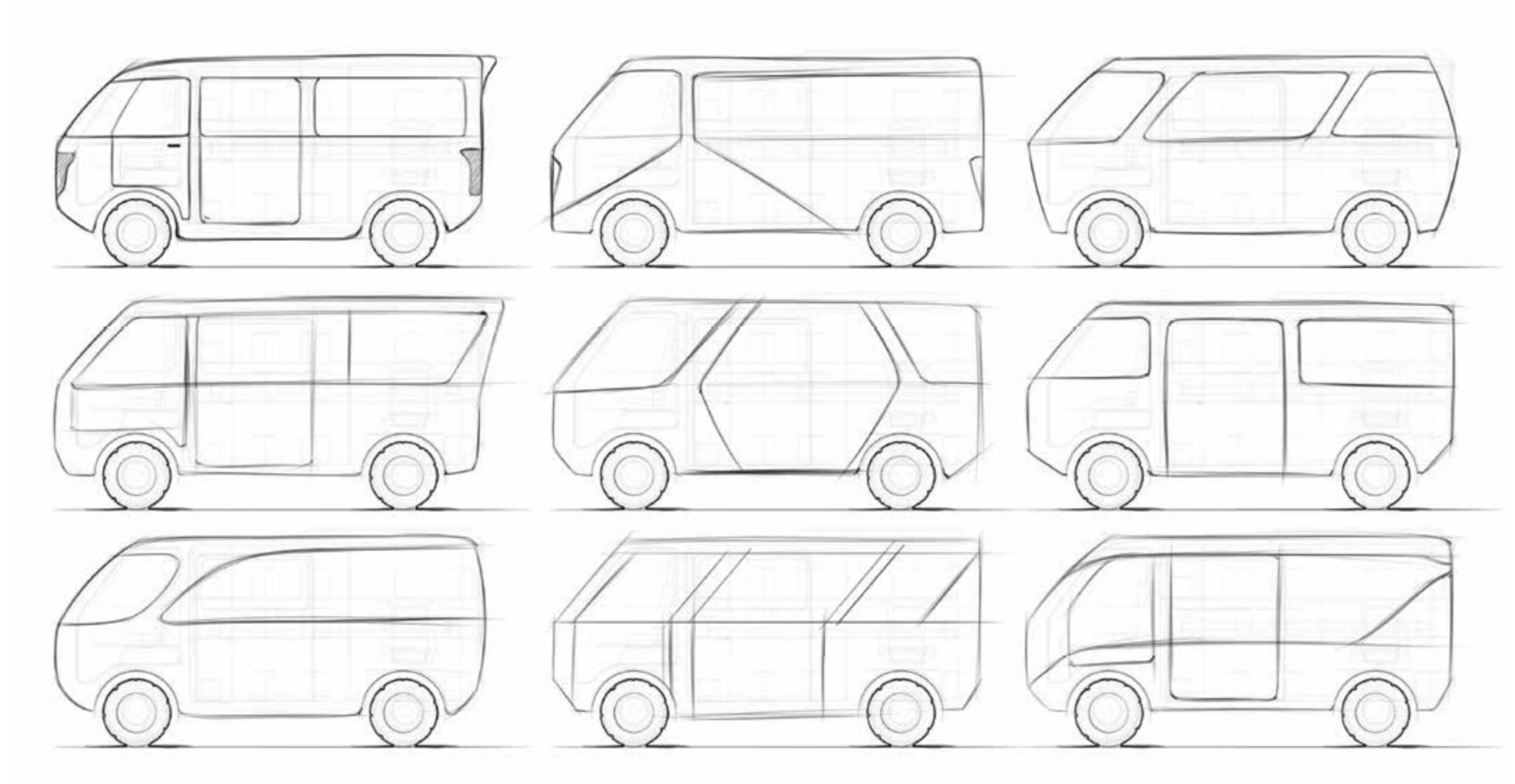
**Comfort**

## 7.6 EXTERIOR DESIGN IDEATIONS

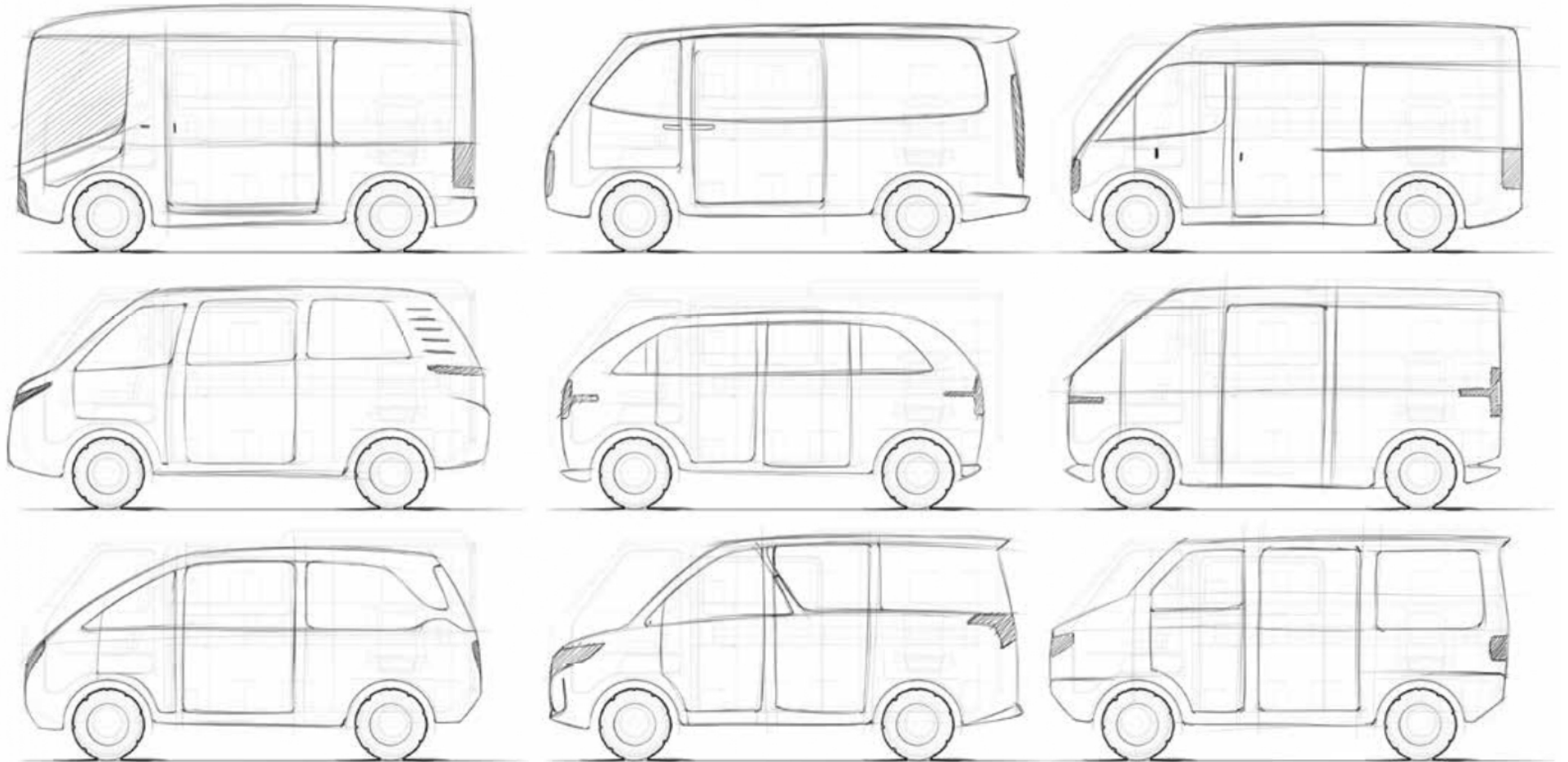
The next stage is ideation exploration. The exterior design of the vehicle should be Voluminous, Accessible, and Modular. It should be designed according to Postman's needs.



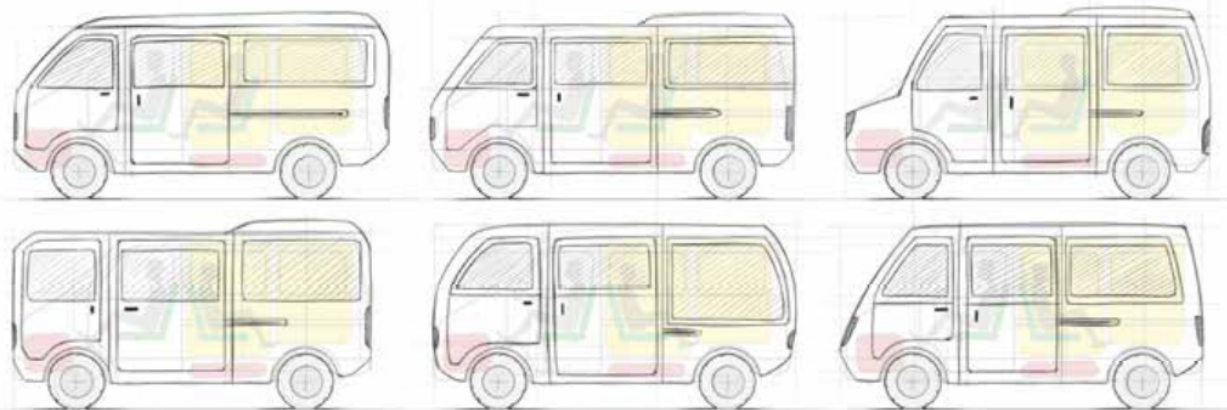
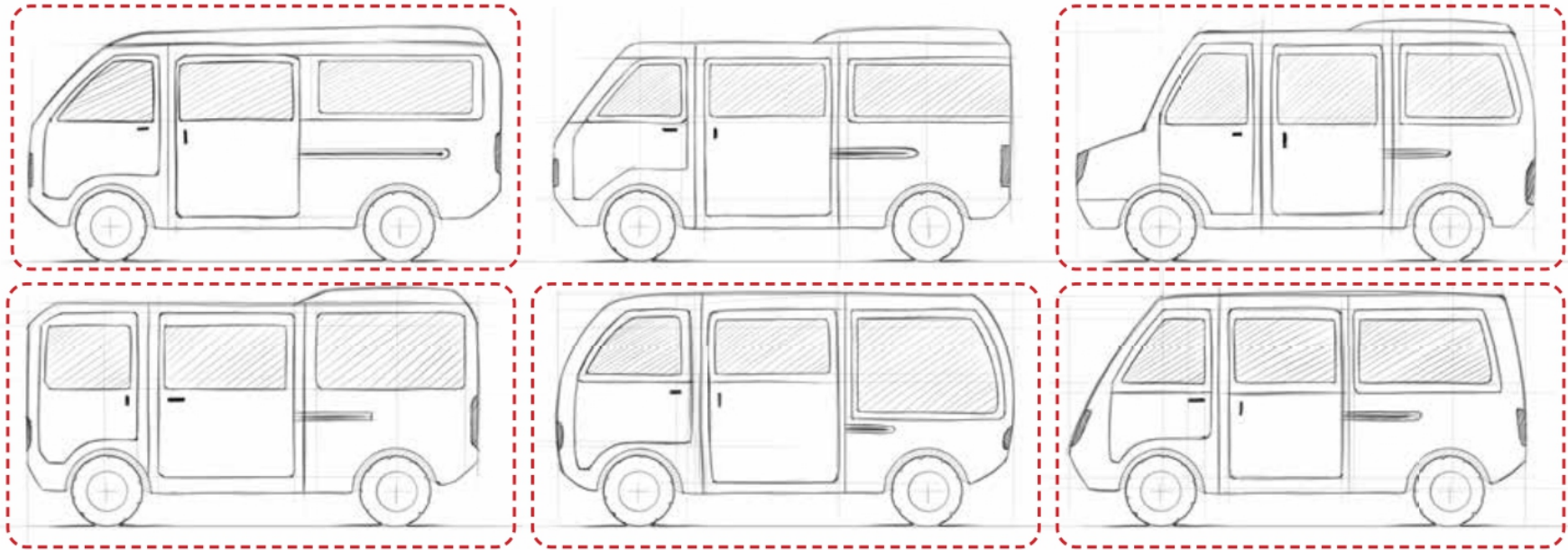
Most of the exterior design ideation exploration-based different volume sizes and shapes were made to correct utility vehicles' proportions.



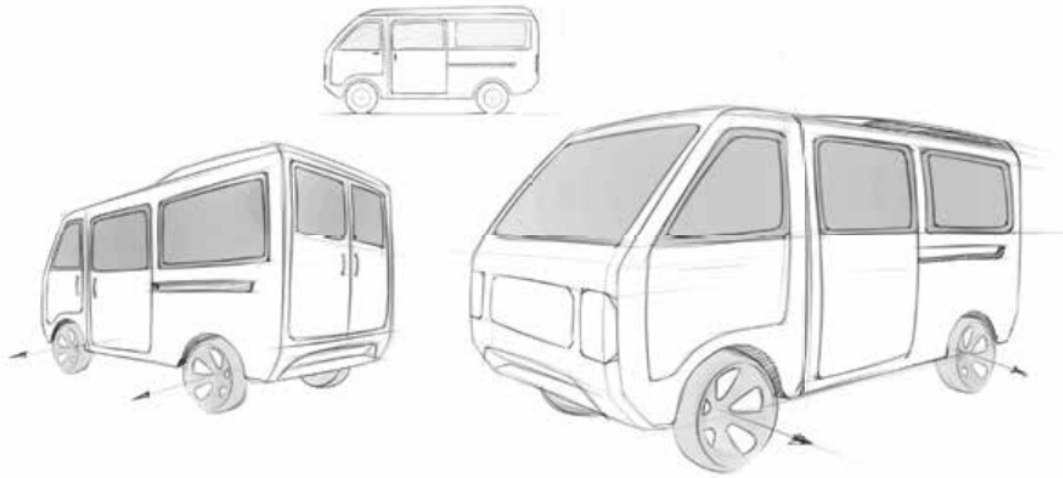
This ideation exploration was made on the existing minivan and utility van to understand the minivan side view evaluation.



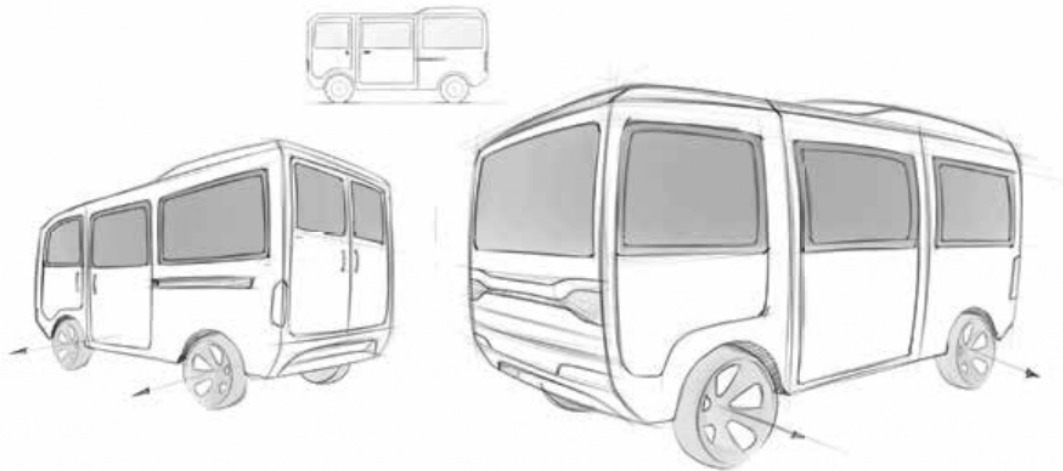
These are a total of 6 key sketches were taken out for future concept development.



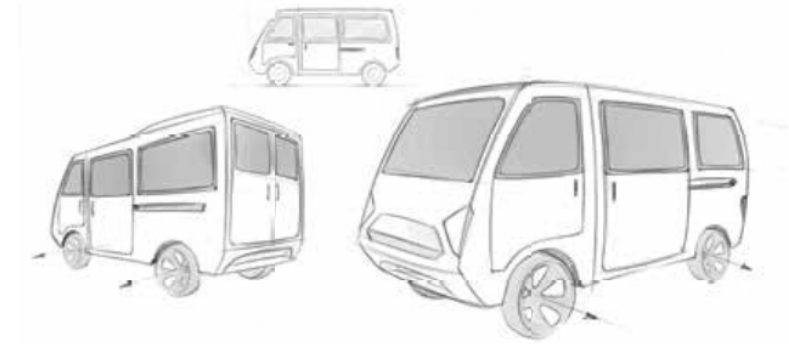
### Concept 1



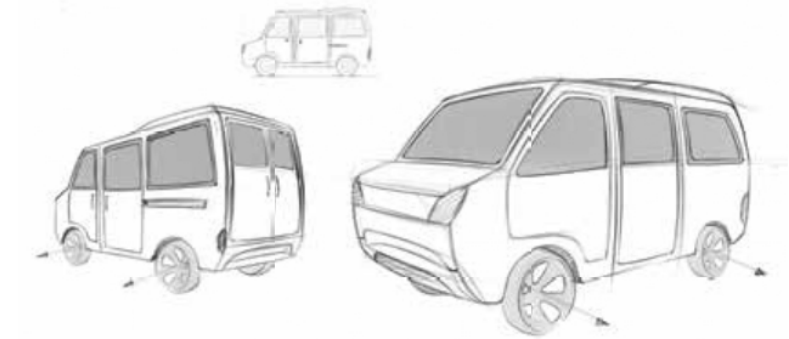
### Concept 2



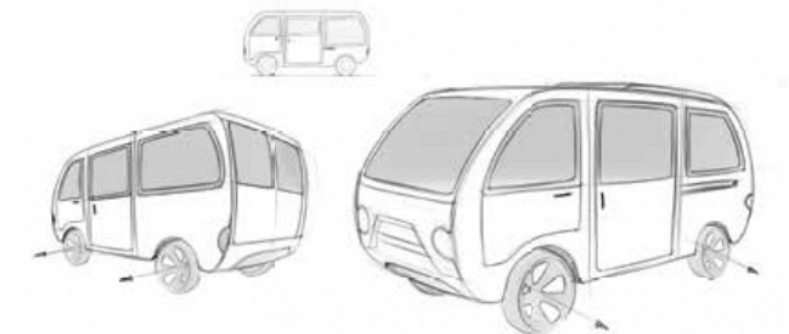
### Concept 3



### Concept 4



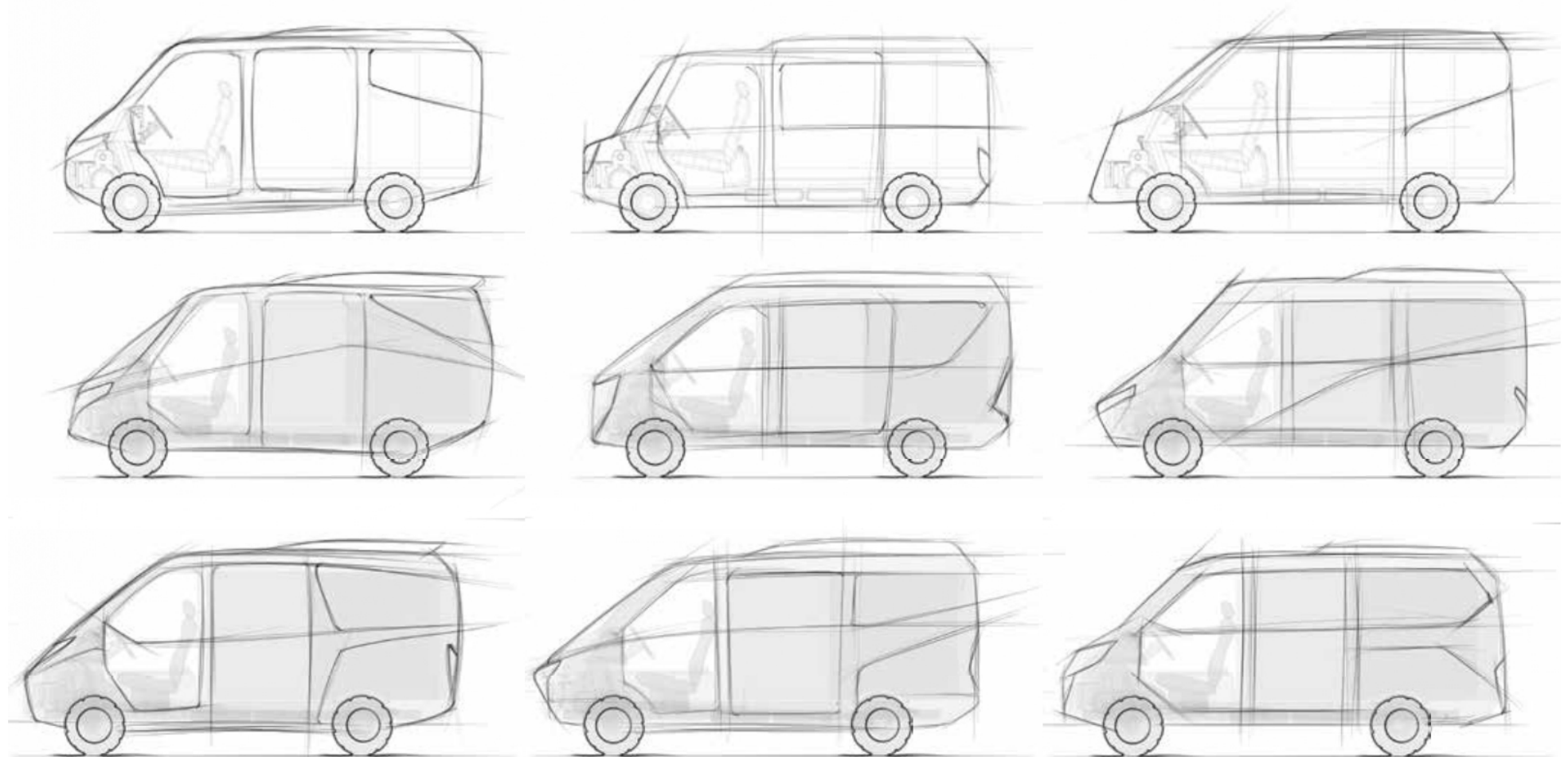
### Concept 5

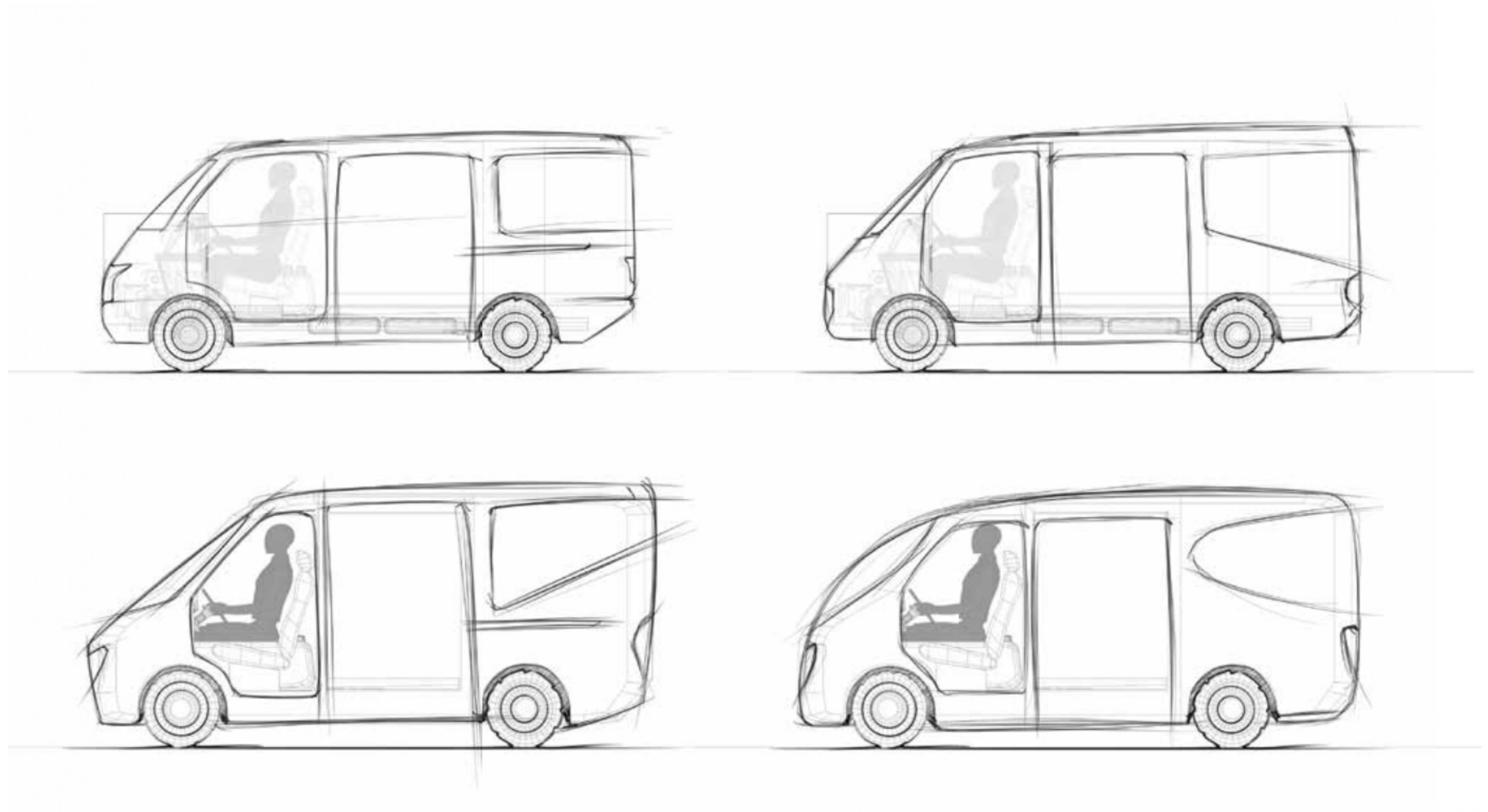


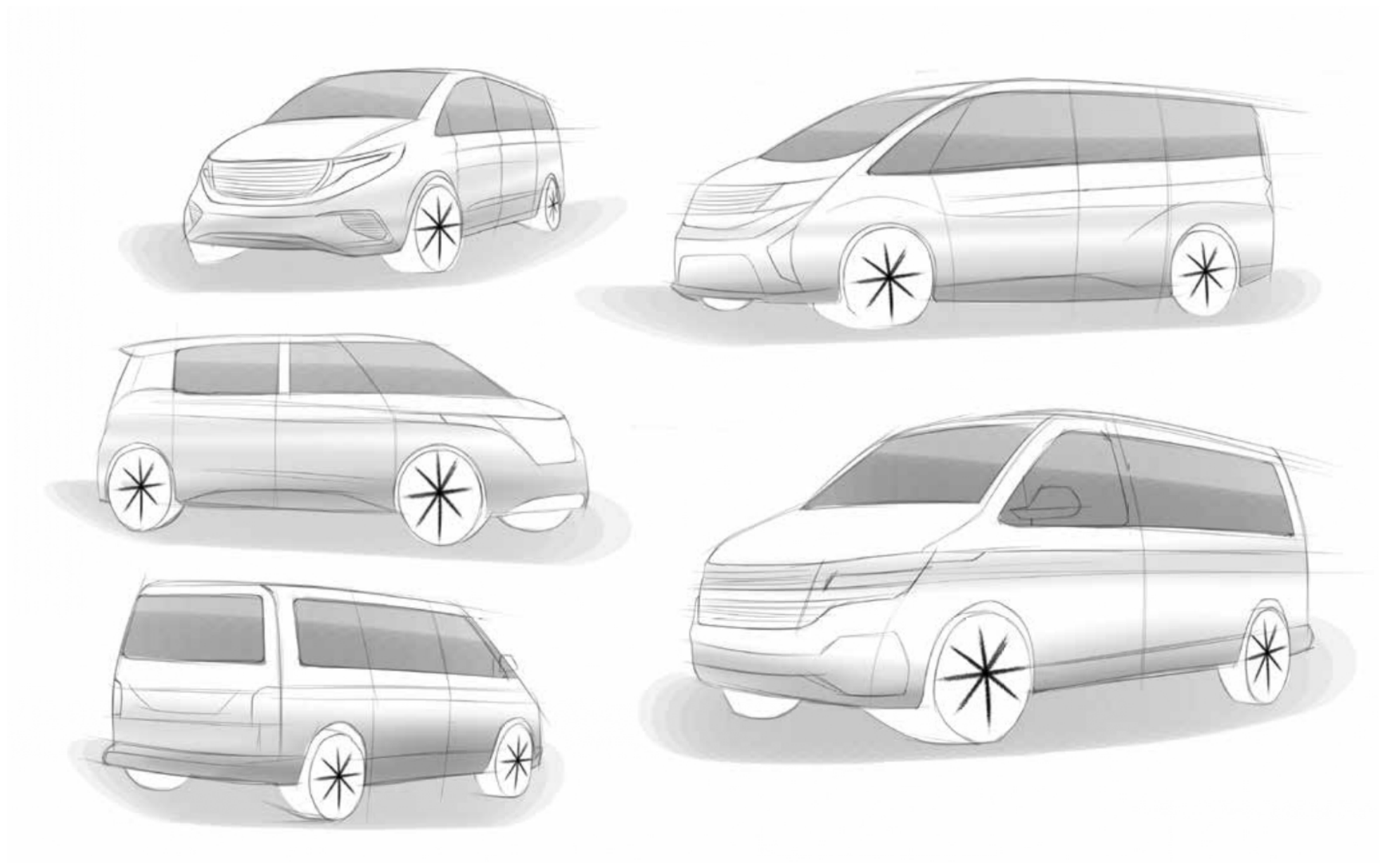


## 7.7 PROPOSAL EXTERIOR CONCEPT

This Idea was made to design several concepts based on final technical packaging, human ergonomics with cargo volume and engine volume for final output exterior design.

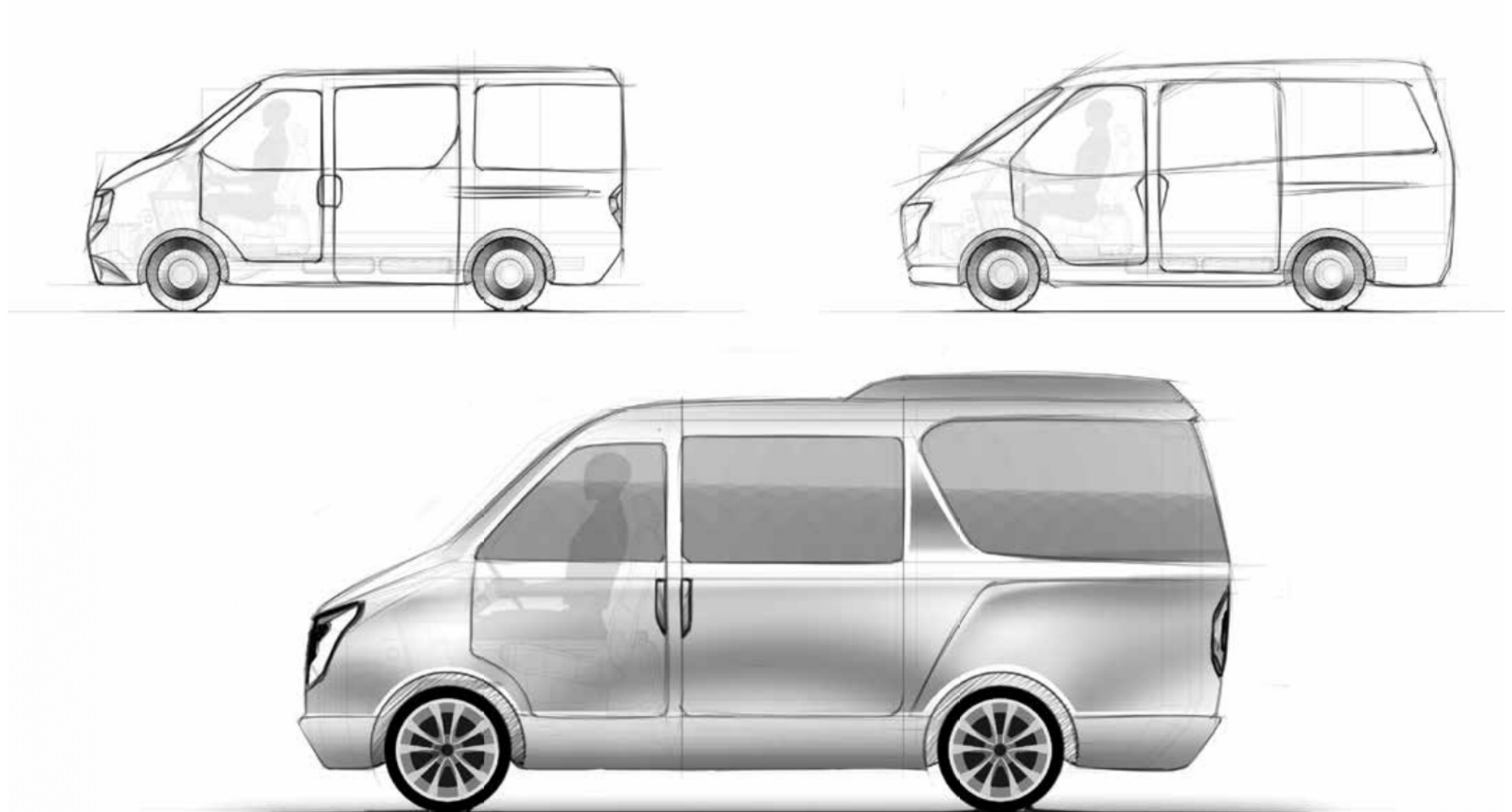






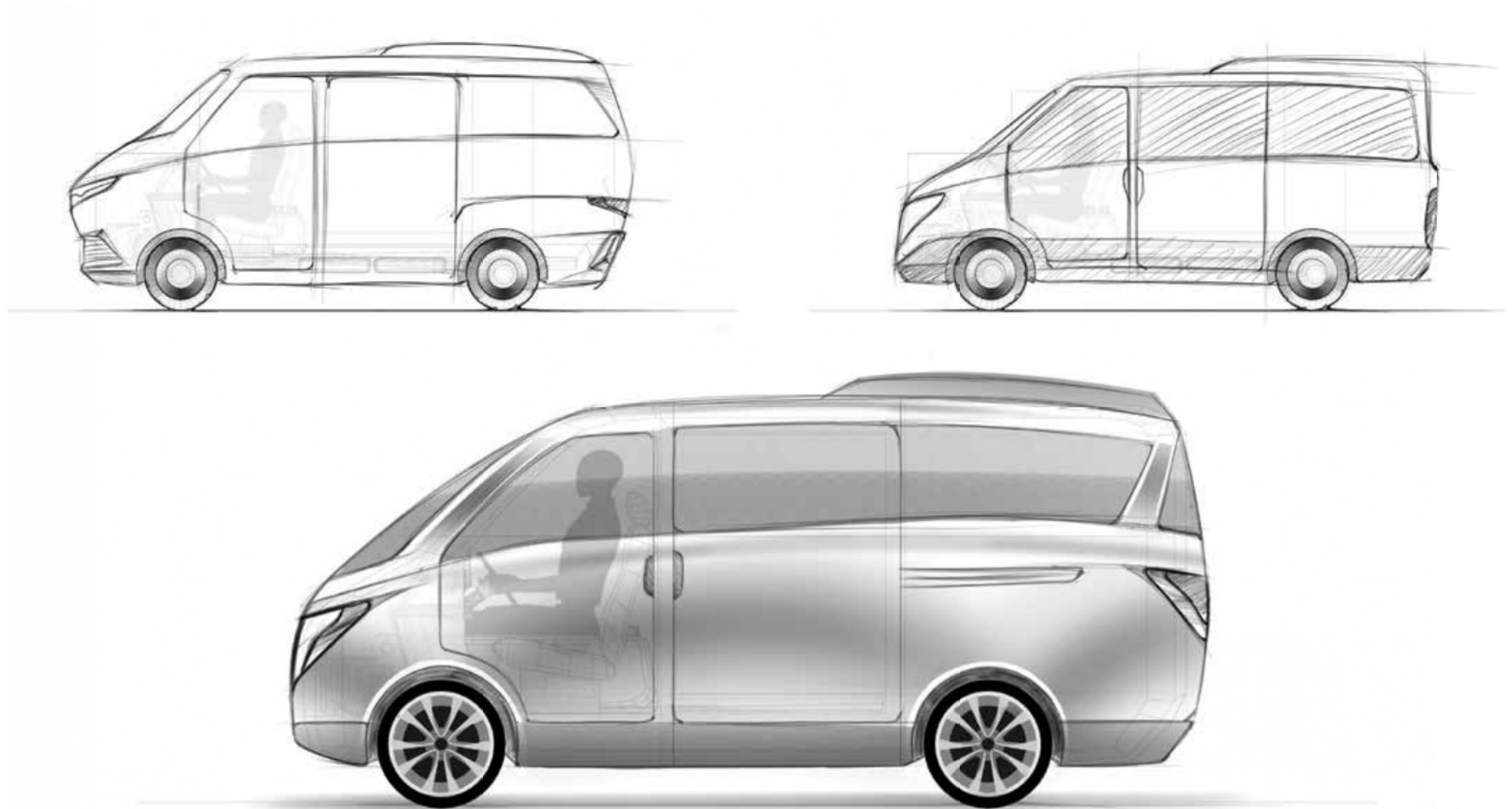
## Concept A

The Concept A idea is to design a strong form and more toward the Voluminous form of the vehicle.



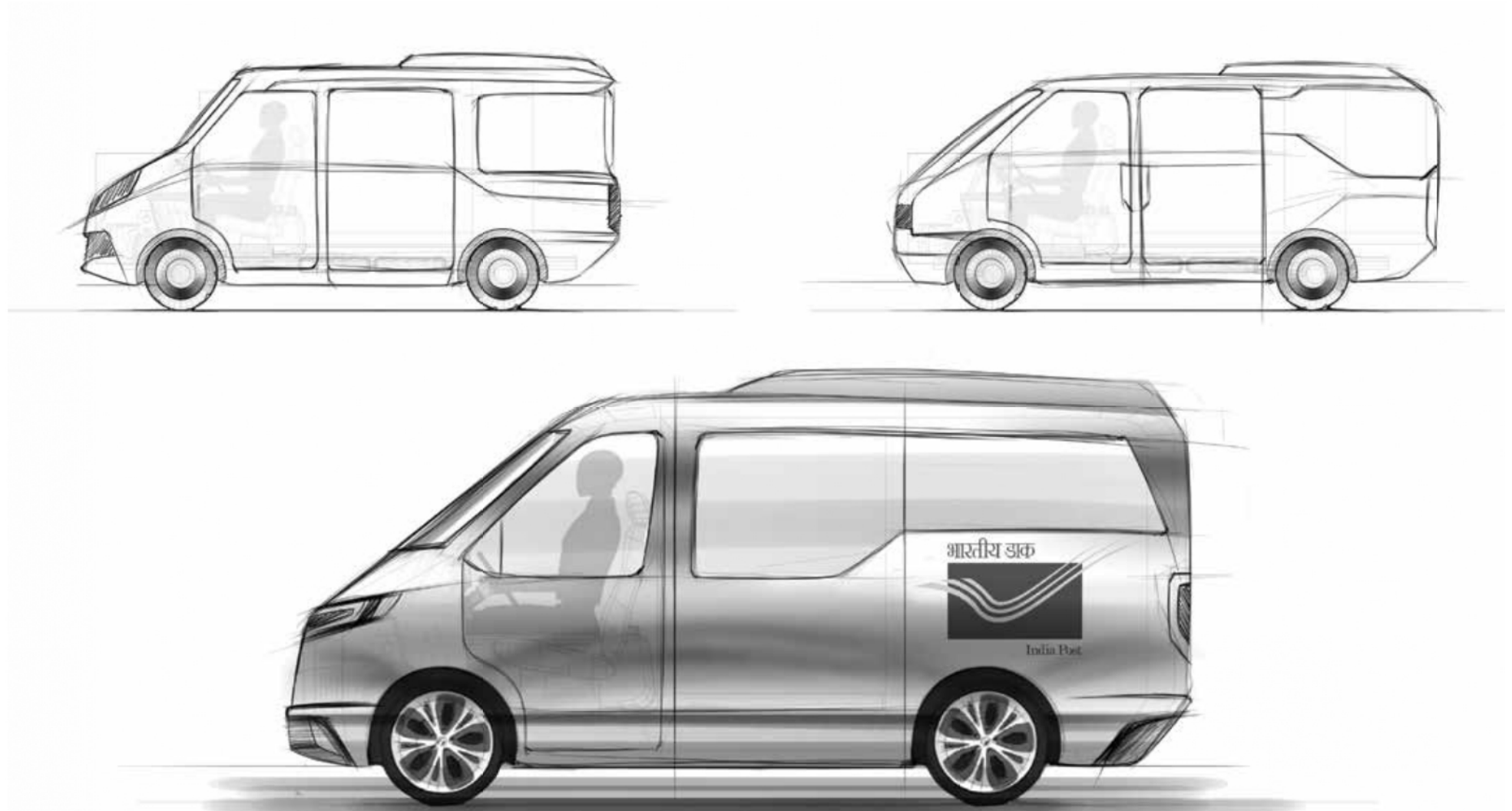
## Concept B

The Concept B idea is to design a smooth form with comfortable looks to get the attention of the customer.



## Concept C

The Concept C idea is to design a utility design form with expanding window side on side view to give better look.



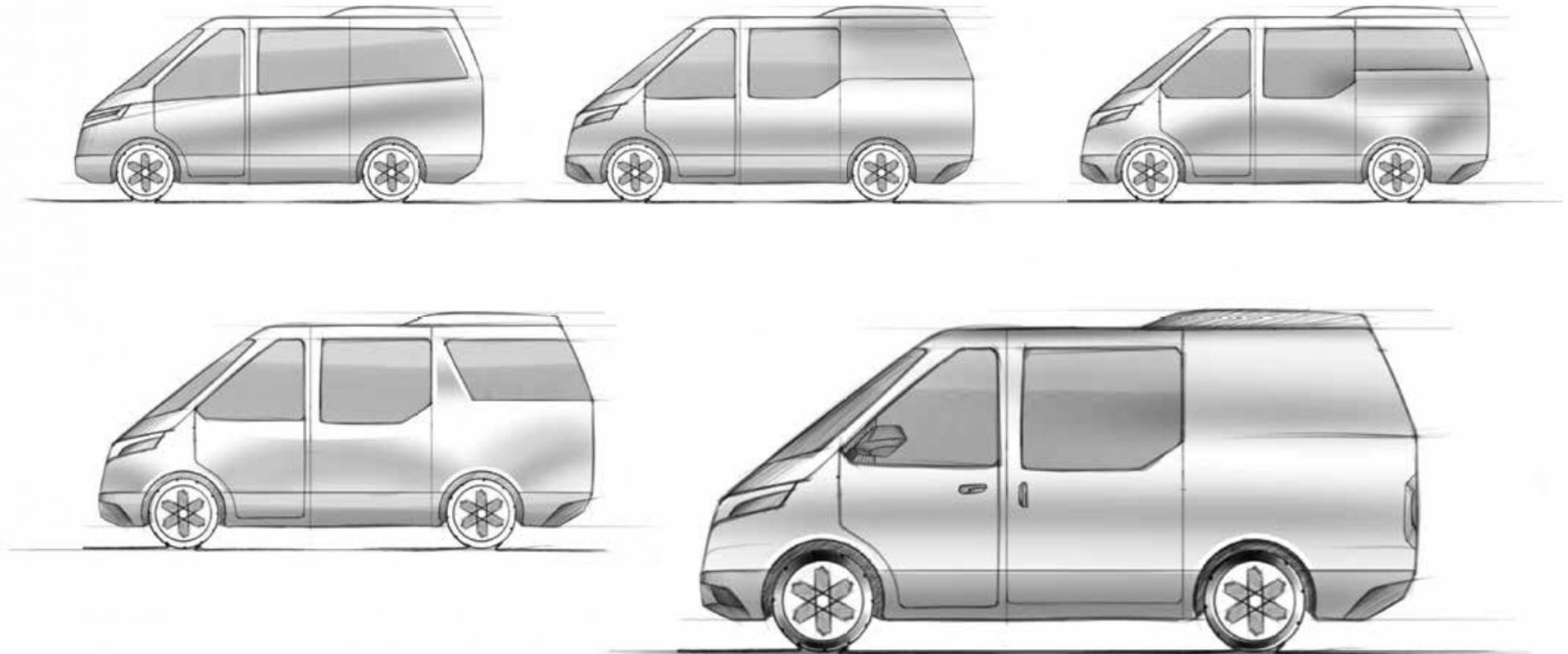
## 8. FINAL CONCEPT DETAILS

At Stage 3, The final 3D Model was made in blender 2.9. Details and packaging storage have been added to show the various features of the vehicle.

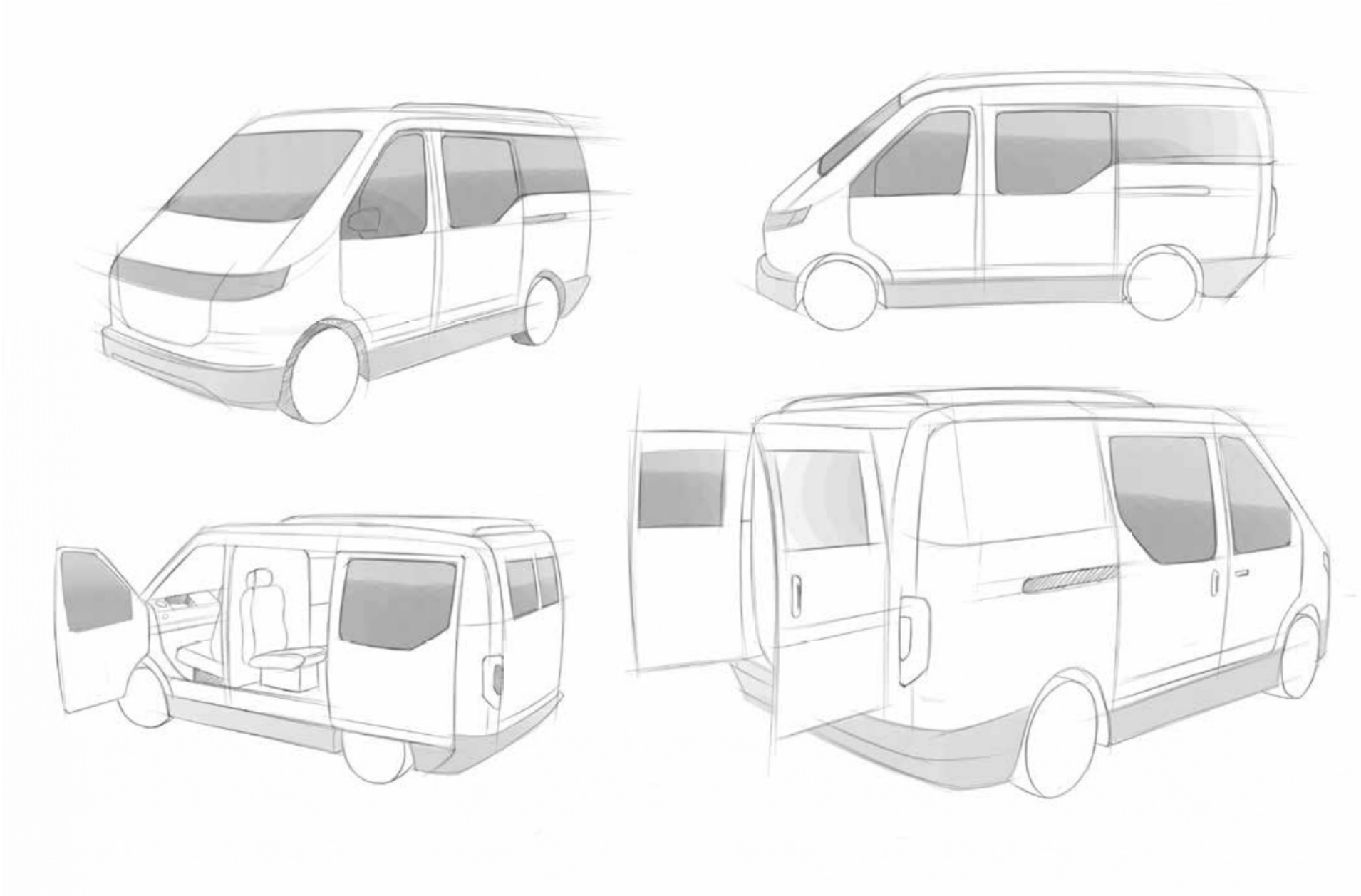
## 8.1 FINAL CONCEPT RENDER

### CONCEPT REFINEMENT

After getting better proportions from different concept ideas. Concept C is taken ahead for further development and many windows door glass ideation sketches were made to get better looks.



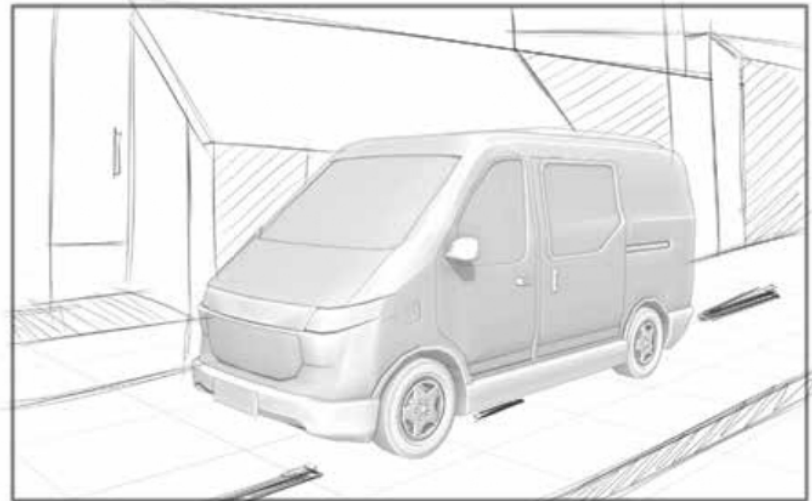
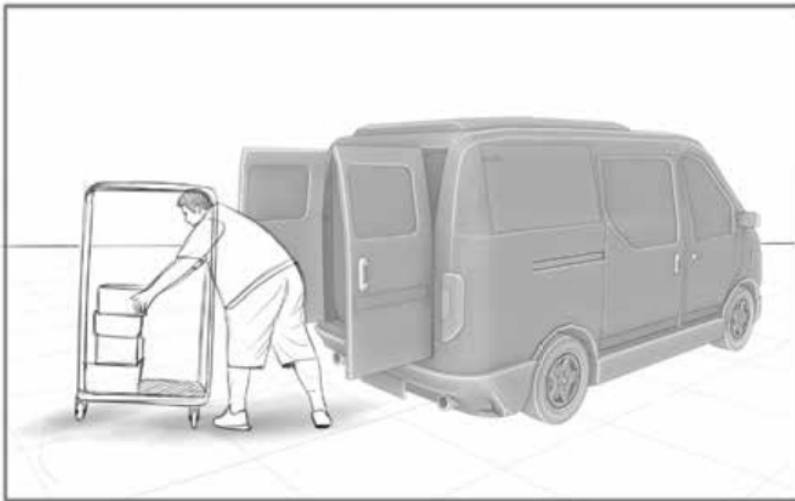
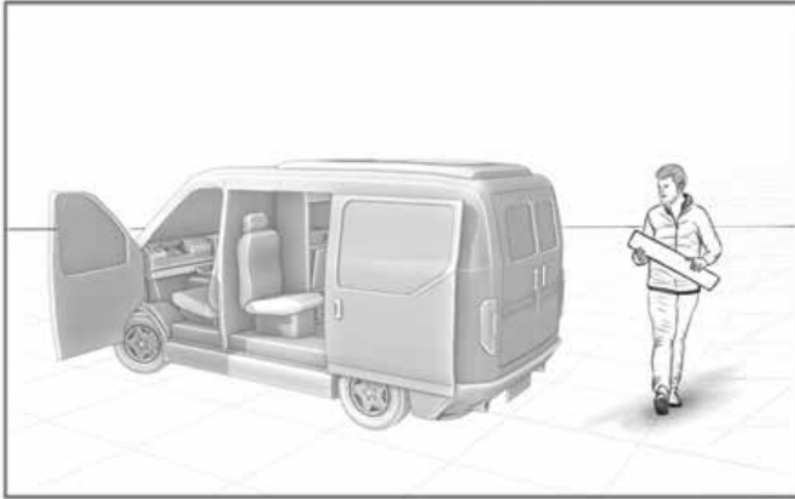




## FINAL CONCEPT RENDER



## STORYBOARD SCENARIO



## 8.2 FINAL 3D CAD MODEL

### FINAL INTERIOR 3D CAD MODEL



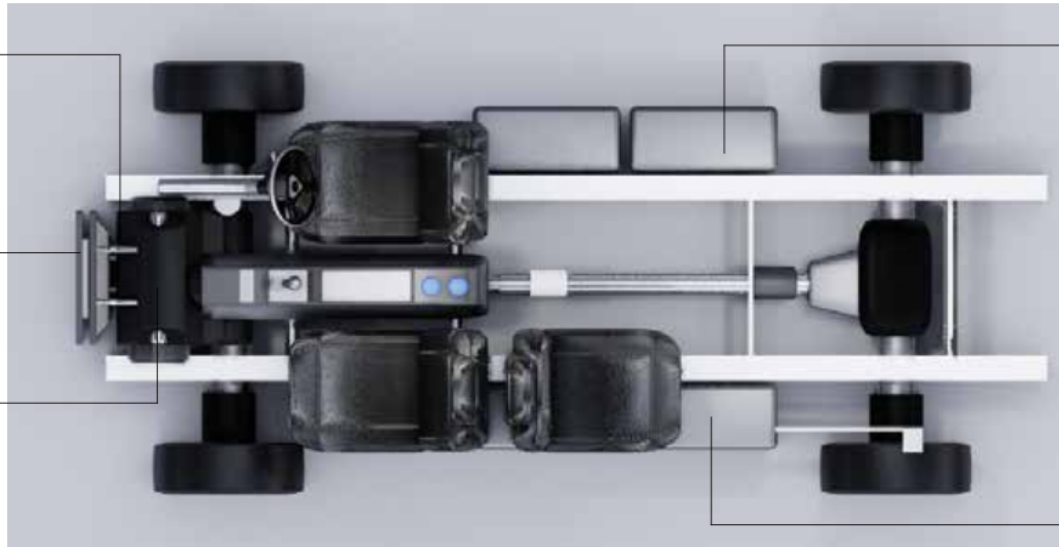
# ENGINE CONFIGURATION

Hybrid Engine with solar energy powered

Internal Combustion Engine  
1000 -1200 cc

Thermal System Cooling

Power Electronic Controller



High Capacity lithium-ion Battery  
25- 35 kWh

Electric Generator & Motor

Transmission

Fuel Tank



150-200 Solar Cell

Solar Power Charging Connector

Exhaust System

# FINAL CARGO STORAGE 3D CAD MODEL

**Cargo Storage 1**

**Cargo Storage 2**

**Cargo Storage 3**

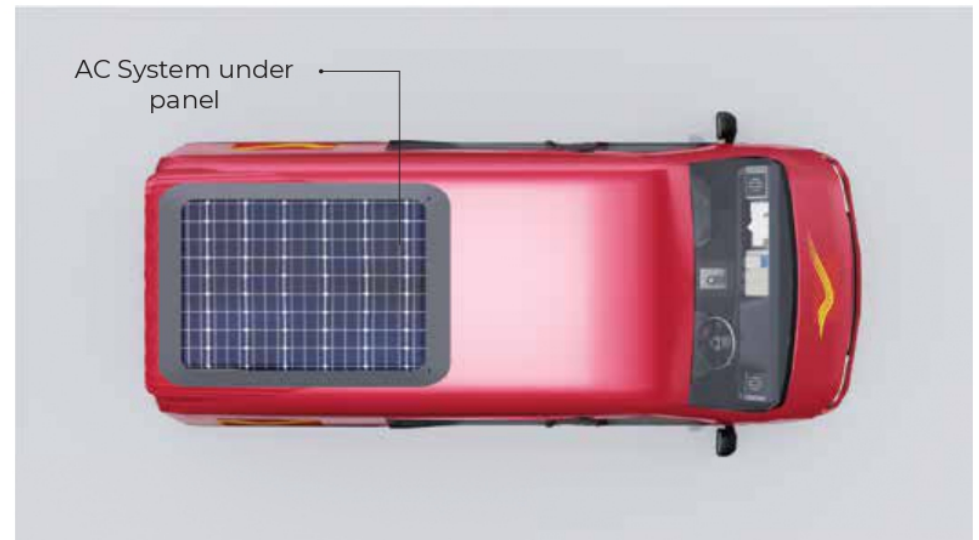


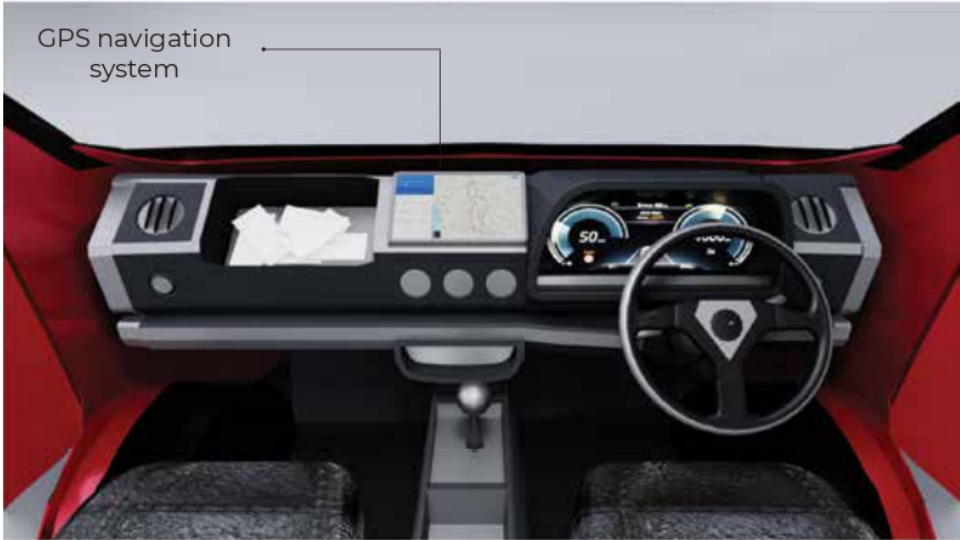
Small  
Parcels

Medium  
Parcels

Large  
Parcels

## Final 3D CAD Model







## INDIA POST MAIL VAN



## INDIA POSTAL DELIVERY SERVICE (Company Brand Platform)



**Amazon postal service**



**FedEx express service**



**BLUEDART service**



**DHL service**

## SCENARIO about postman when they handling parcels





Solar Vehicle of Enhanced Delivery Transport For The Postal Department



Solar Vehicle of Enhanced Delivery Transport For The Postal Department



Solar Vehicle of Enhanced Delivery Transport For The Postal Department



Solar Vehicle of Enhanced Delivery Transport For The Postal Department



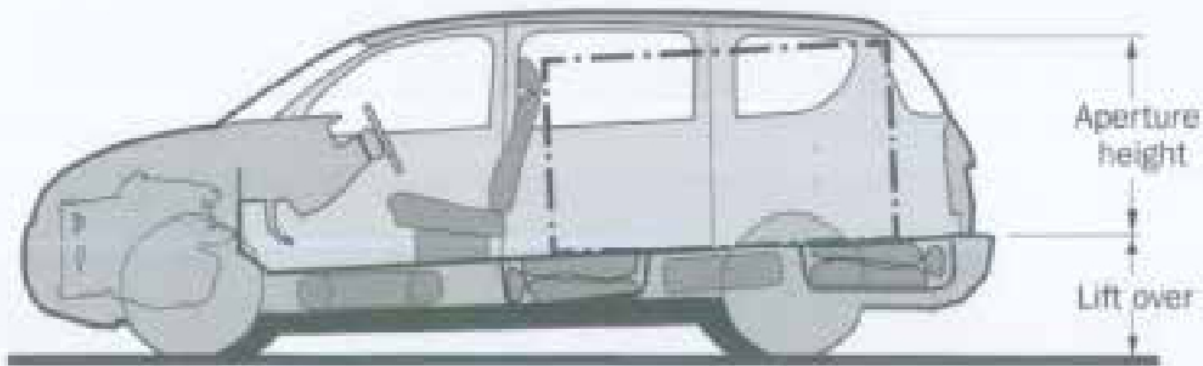
Solar Vehicle of Enhanced Delivery Transport For The Postal Department



## REFERENCES

- <https://www.theweek.in/news/sci-tech/2019/01/04/India-first-ever-self-driving-solar-powered-bus-hits-the-road.html>
- <https://www.tno.nl/en/focus-areas/energy-transition/roadmaps/renewable-electricity/solar-energy/integration-solar-energy-environment/solar-powered-transportation/>
- <https://goobjoog.com/english/galinsoor-administration-trucks-water-village/>
- [https://www.business-standard.com/article/companies/mahindra-mahindra-gets-patent-for-solar-power-system-on-vehicle-rooftops-119103101153\\_1.html](https://www.business-standard.com/article/companies/mahindra-mahindra-gets-patent-for-solar-power-system-on-vehicle-rooftops-119103101153_1.html)
- <https://www.eqmagpro.com/solar-energy-the-future-of-indias-automobile-industry/>
- <https://economictimes.indiatimes.com/industry/telecom/telecom-news/only-discoms-are-authorized-to-install-rooftop-solar-plants-empanel-vendors-govt/articleshow/80290488.cms?from=mdr>
- <https://www.thebetterindia.com/118315/chennai-mobile-post-office-speed-post/>
- <https://www.forbesindia.com/article/the-unsung-heroes-of-covid19/unsung-heroes-postal-workers-delivery-executives-who-worked-tirelessly-amid-lockdowns/65539/1>
- <https://www.solon.com/global/company/solar-mobility/Why-Solar-Mobility/index.html>
- [https://en.wikipedia.org/wiki/World\\_Solar\\_Challenge](https://en.wikipedia.org/wiki/World_Solar_Challenge)
- <https://www.businessinsider.com/toyota-solar-powered-e-car-never-needs-charging-2019-9?IR=T>
- <https://www.eqmagpro.com/canoo-unveils-all-electric-multi-purpose-commercial-vehicle/>
- [https://en.wikipedia.org/wiki/Next\\_Generation\\_Delivery\\_Vehicle](https://en.wikipedia.org/wiki/Next_Generation_Delivery_Vehicle)
- [https://business.help.royalmail.com/app/answers/detail/a\\_id/89/~/-size-and-weight-guide-%E2%80%93-uk-letters-and-parcels](https://business.help.royalmail.com/app/answers/detail/a_id/89/~/-size-and-weight-guide-%E2%80%93-uk-letters-and-parcels)
- <https://www.kalyanimotors.com/commercial-cars/eeco-cargo>



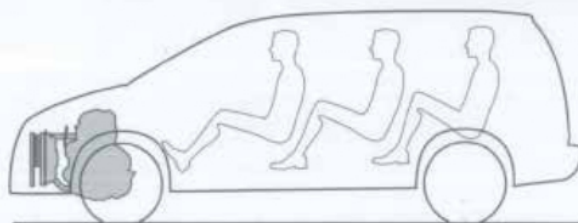


### MINIVANS

The angled floor provides a low step in height for the driver and a lift over at the rear bumper height. Loads are easier to move around if the floor is flat. The underbody components are designed around stowing the seats.

### OCCUPANTS & CARGO

Minivans require a very efficient package and put great emphasis on the occupants. The transverse engine and transmission occupy only a small portion of the architecture. Because all of the powertrain components are in front of the occupants' feet, the entire floor can be designed flat.



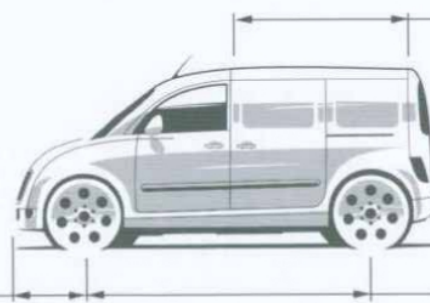
### COMMERCIAL VEHICLES

To optimize the vehicle length, the driver is often pushed forward in the package. To improve foot swing, the forward cut line will track around the wheel house. This is only possible with a high floor structure. Note the straight, vertical cut line at the front of the sliding cargo door. This is not possible with a conventional swinging door.



### RWD / FWD

The front wheel is set forward to allow the driver to be located in a forward location.



Rear cargo bay length is determined by functional requirements.

The rear wheel location is set behind the side load door which is designed to allow specific items to pass through, which are usually over 1000mm.



### SLIDING

Often applied to minivans and commercial vans. Ideal for situations where an out swinging door is dangerous or impractical. Sliding door systems require enough room behind the door to build in a straight, horizontal track which will carry the door to the fully opened position. These systems can be electrically operated.



### REAR SWING DOORS

Used mostly on commercial applications. The double doors are designed to be used individually or together. They are often designed to open to 180 or 270 degrees to provide easy access from the side.