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Leadership in Mobility-as-a-Service (MaaS)

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Forecast 2050

9 billion

Population

70%

live in Cities

80%

Ordered goods from other countries

Cities need Smart Mobility solutions!

As core to Digital Transformation, companies need to complement their Digital Innovation efforts with approaches for Digital Disruption

Digital Innovation
in core Business

Digital Disruption
New Business

Digital Transformation

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The dimensions of disruption of the automotive industry

50% Software & Services

90% AI-based Software & Services

90% AI-based Software & Services


e-tron

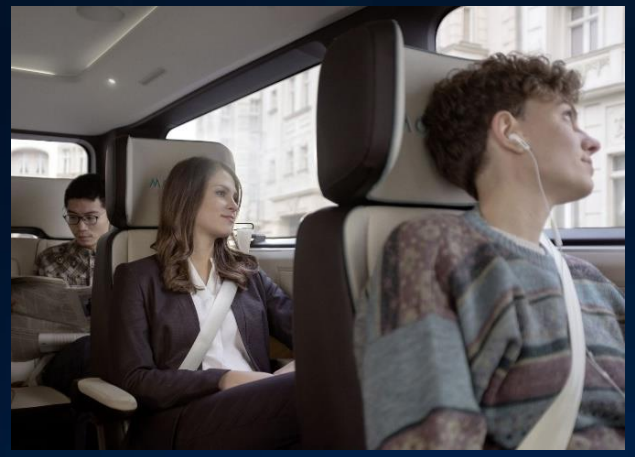

BEV
BEV
SCANIA


MAN
M AN 580

Self-Driving Vehicles | What if…

…users immediately get picked up by a **self-driving vehicle at the push of a button**,…

…at **a price that is lower than a personal car**, but with an equally great experience,…



…and **offer mobility for all people, also the blind, elderly and children**, and let everyone spend more time on things they truly care about?

Human Thinking

Human Thinking

The self-driving system as the heart of the automobile

- 360° laser, radar, cameras and ultrasonic/short range sensors
- Central computing unit
- Redundancy
- Artificial intelligence-based software: Perception, Sensor Fusion, Object Detection, Situation Analysis, Path Planning, Decision Making, Localization & Learning HD-Map

Human Thinking

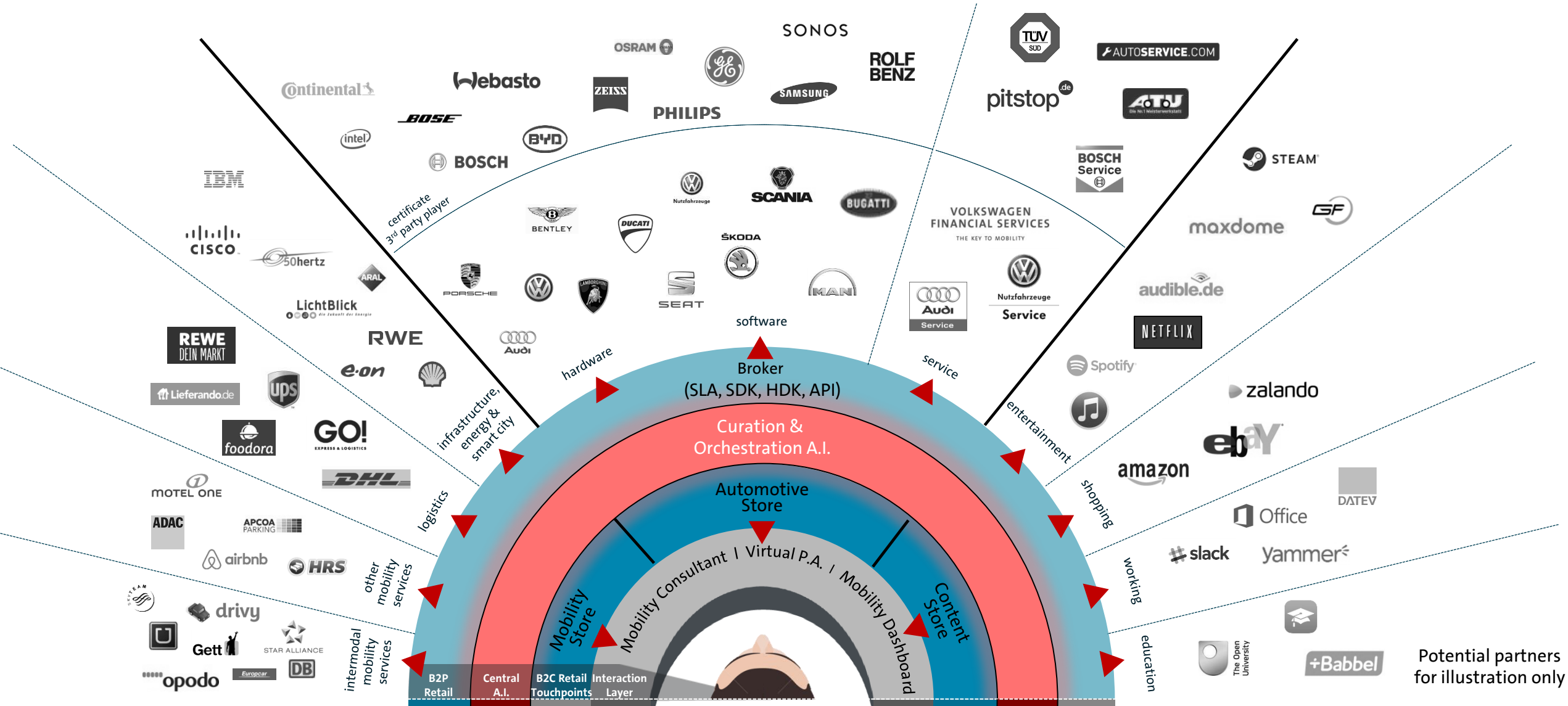
Safety – Self-Driving Vehicles

- don't drink and drive
- don't text and drive
- don't take drugs and drive
- don't get agitated and disappointed about others
- don't get distracted
- don't fall asleep while driving
- don't need a second reaction time
- don't run red lights
- don’t have limited view
- don't speed…

Human Thinking

37,668 hours

Human Thinking



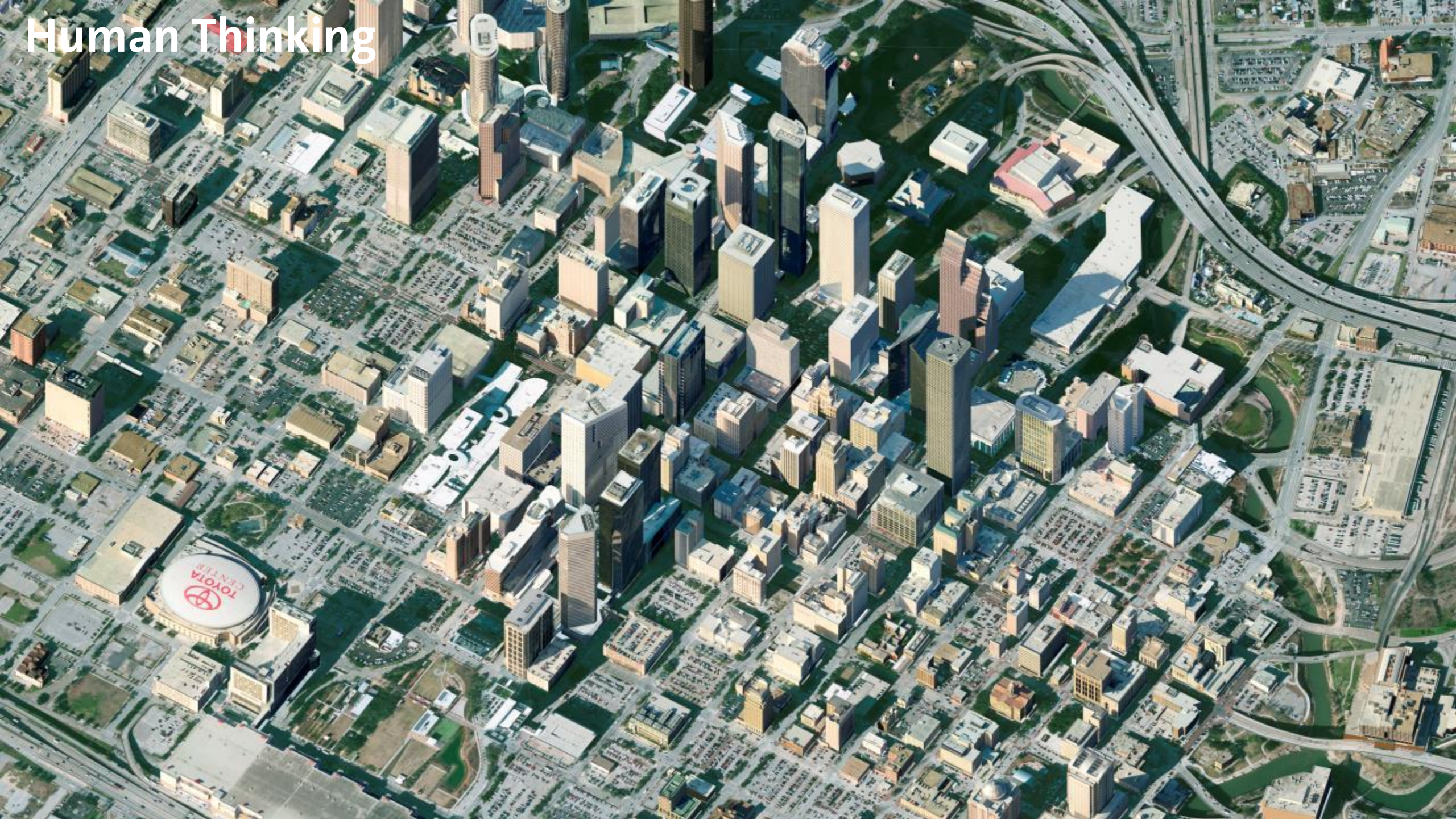
Human Thinking

Accessibility for EVERYONE
Will increase Social Mobility!

Human Thinking

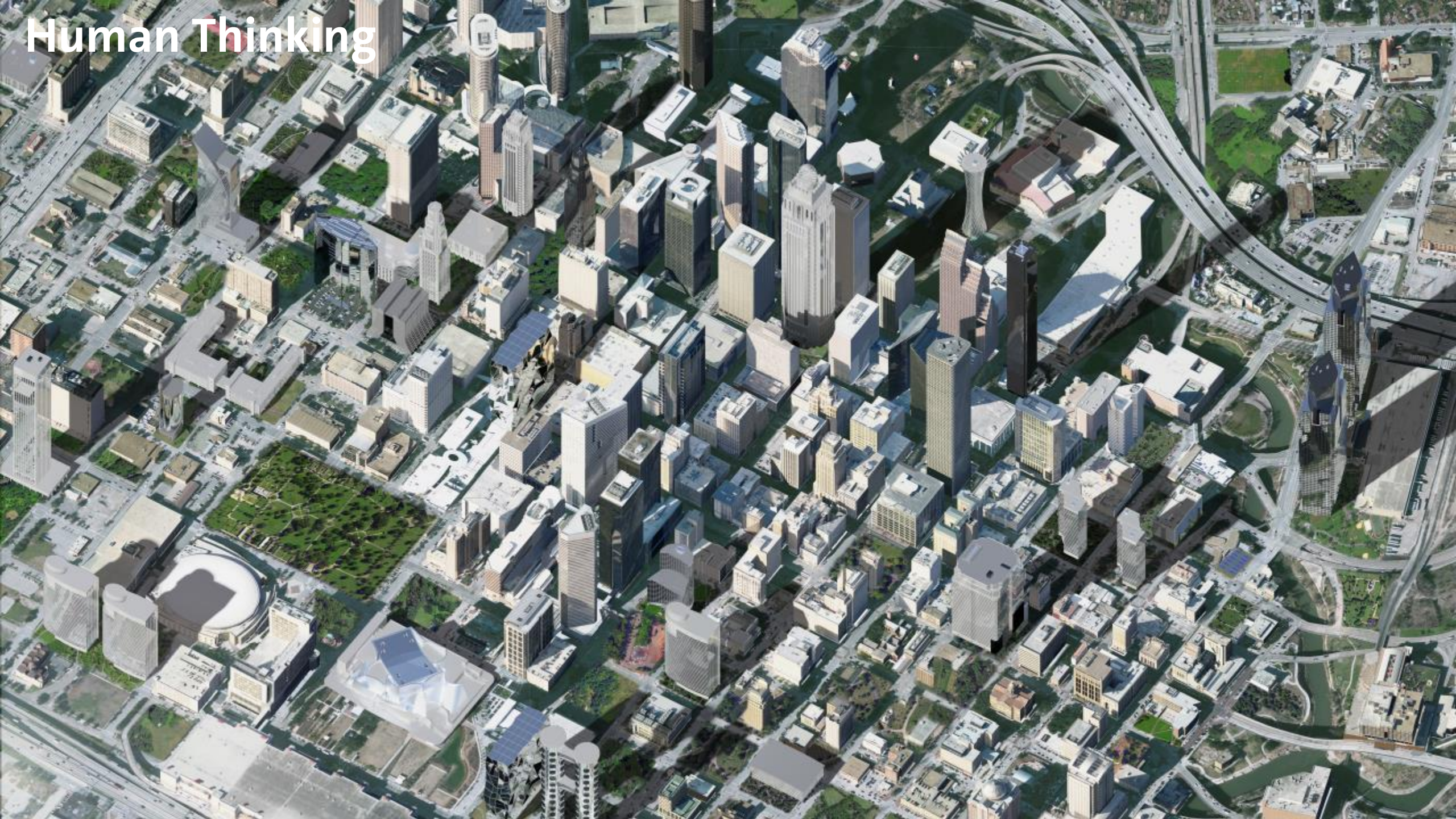
Human Thinking

Human Thinking



Human Thinking

Human Thinking



Human Thinking

Clean, Park & Charge Towers

Self-Driving System as the next core invention

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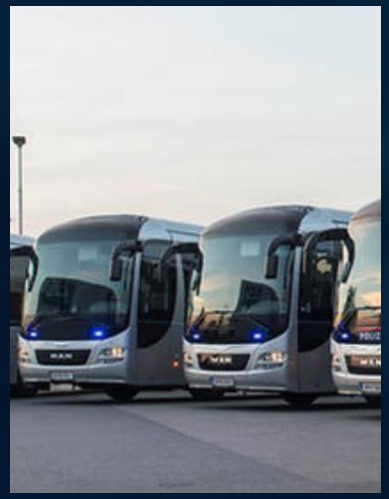
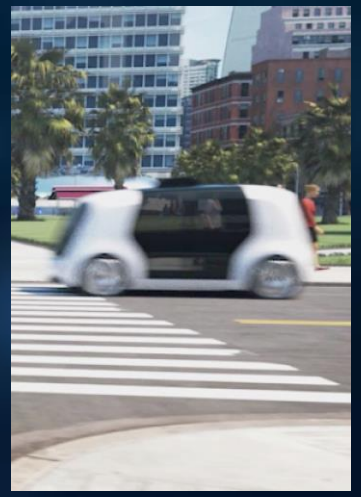
Our Competitive Advantage:
Cover All Fields of Application

Passenger Cars

Trucks & Utility Vehicles



Busses



New Mobility-as-a-Service (MaaS) Vehicles

New Vehicle Concepts for Owned Autonomy

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Self-Driving Vehicles Use-Cases

Autonomous Driving

Ownership

Mobility-as-a-Service for People

Pod

Shuttle

Mobility-as-a-Service for Goods

Urban

Highway

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Business Disruption of the Automotive Industry:

Mobility-as-a-Service (MaaS)

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Mobility-as-a-Service (MaaS)

Value Layers & Profit Pools

Layer 5: Content & Services Provider

Layer 4: Mobility Provider

Layer 3: Fleet Operator

Layer 2: Automotive OEM

Layer 1: Self-Driving System Provider

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Mobility-as-a-Service (MaaS) Vehicles
are developed under new requirements

High relevance
Low relevance

Redundancy

Availability

Security

Vehicle Lifetime

Customer-Centric

Driving Behavior

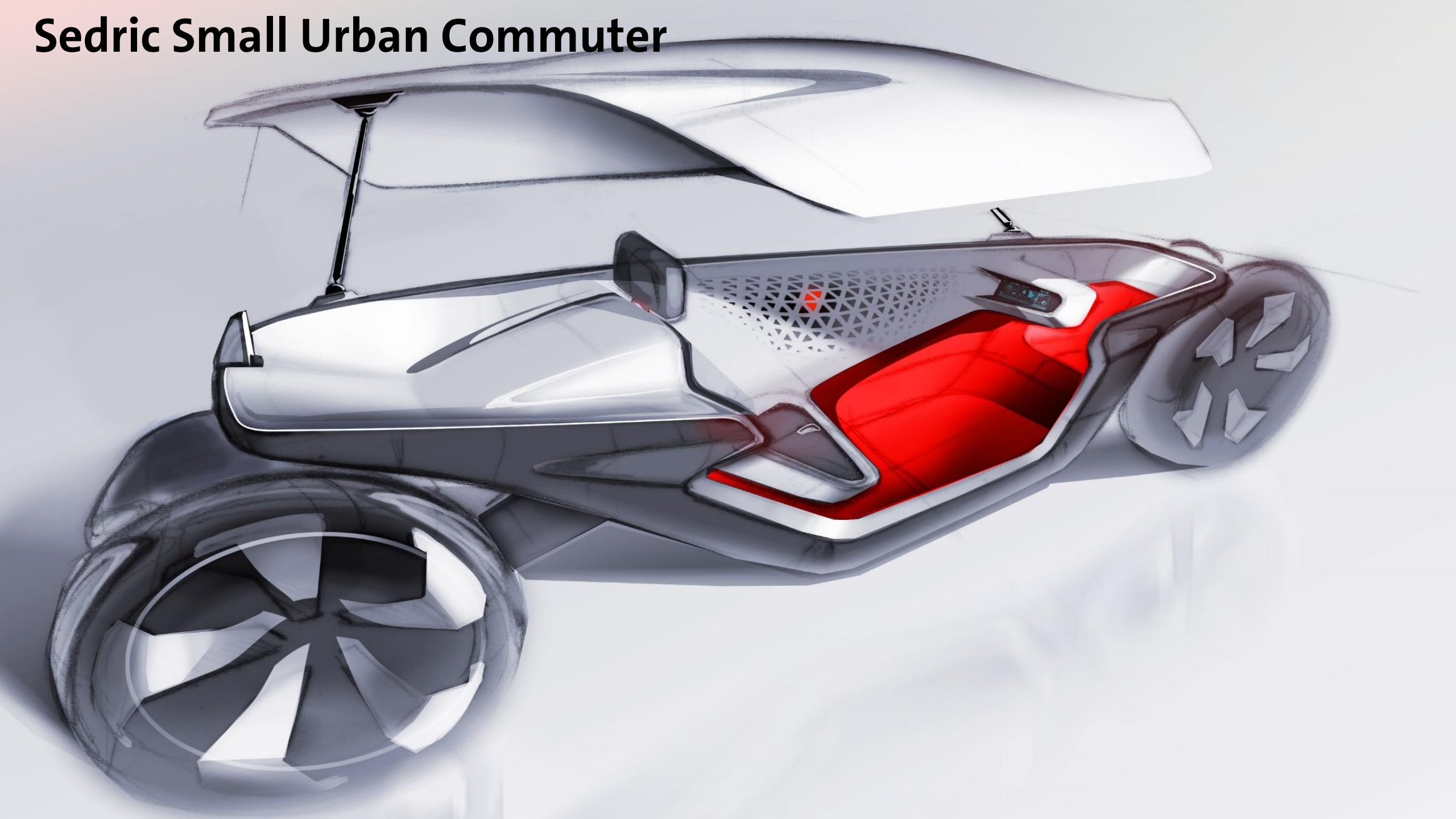
Cost-per-passenger-km

Powertrain

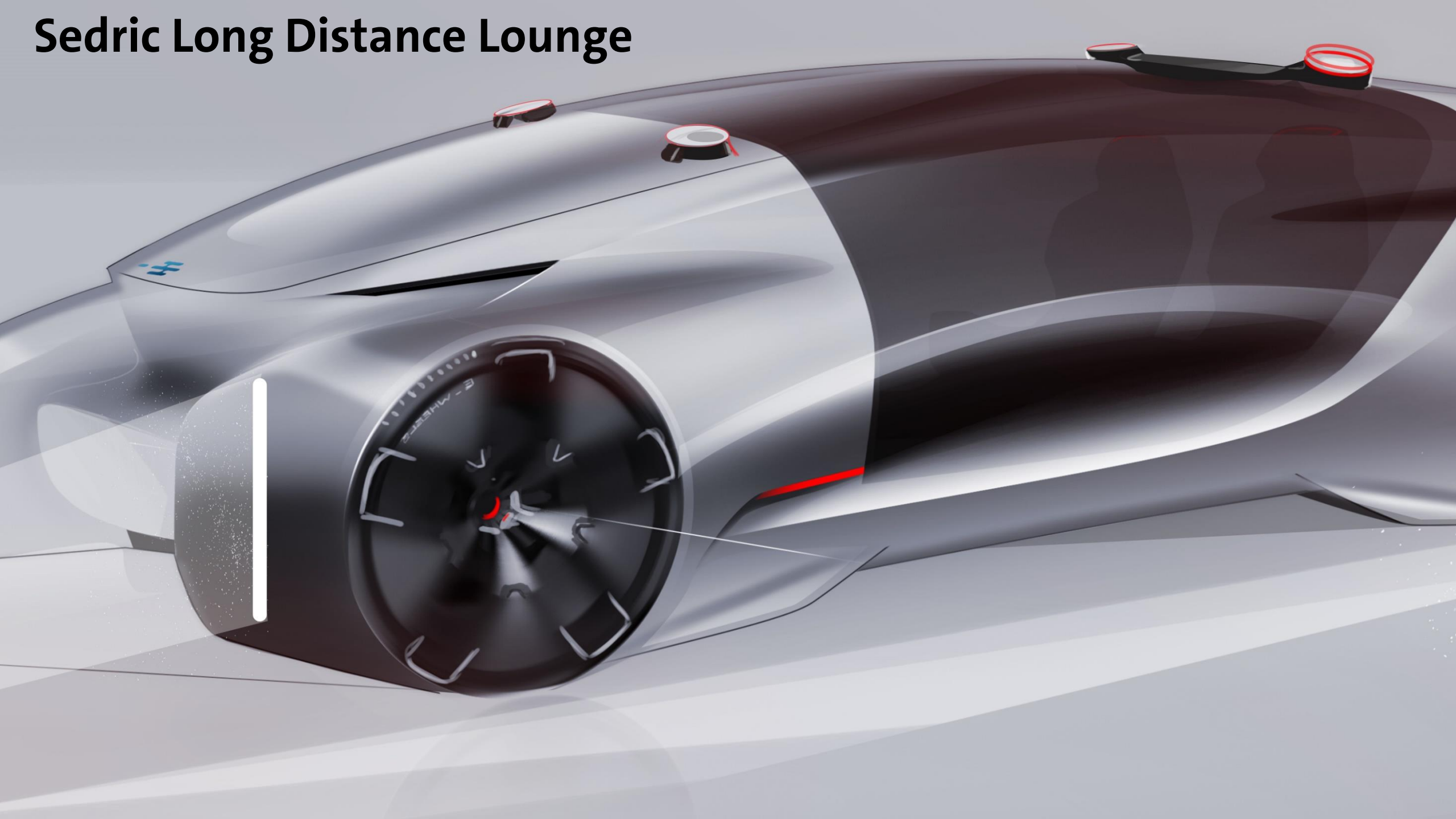

AICON

Sedric Urban Pod

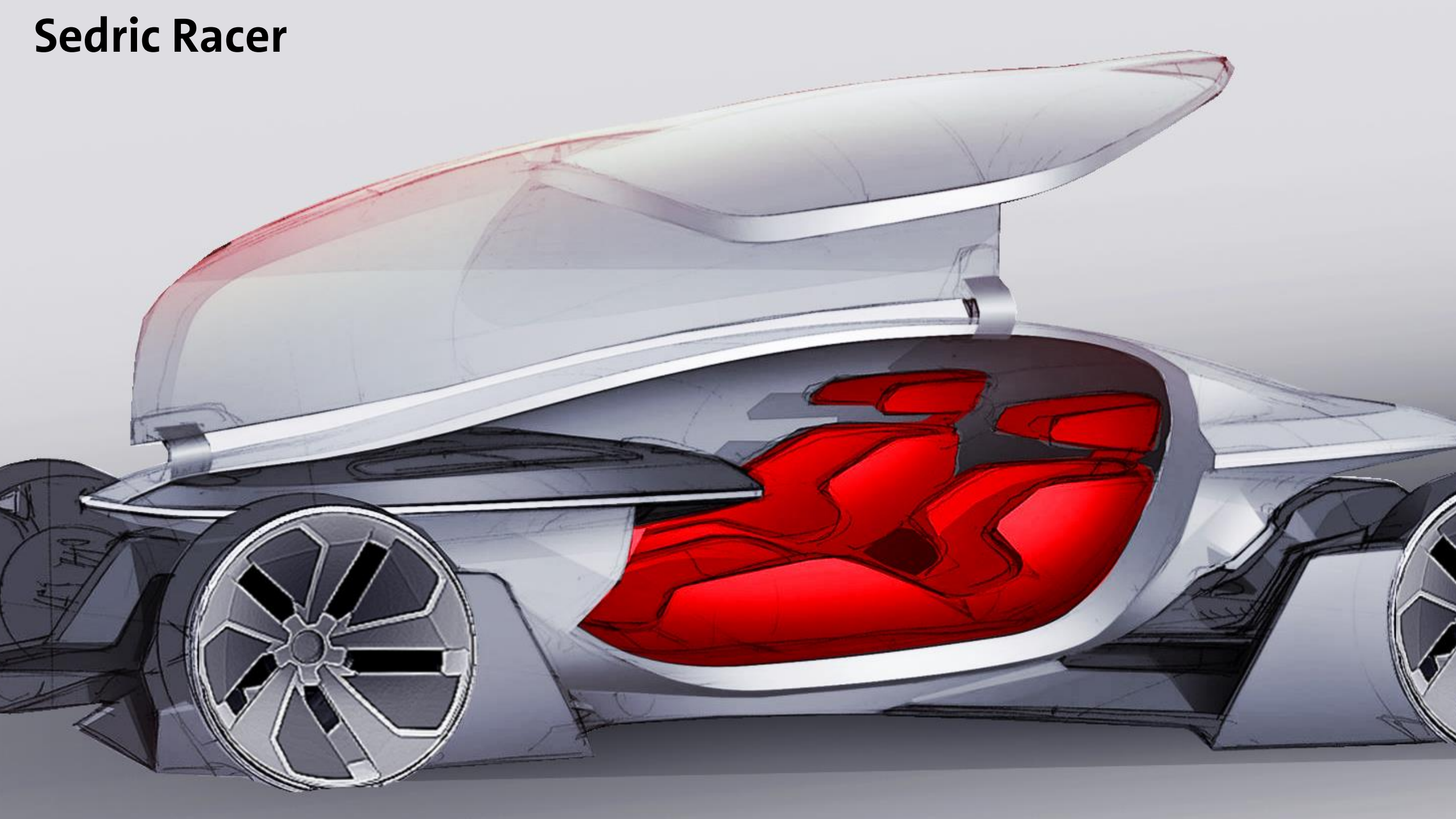
Sedric Small Urban Commuter



Sedric Long Distance Lounge

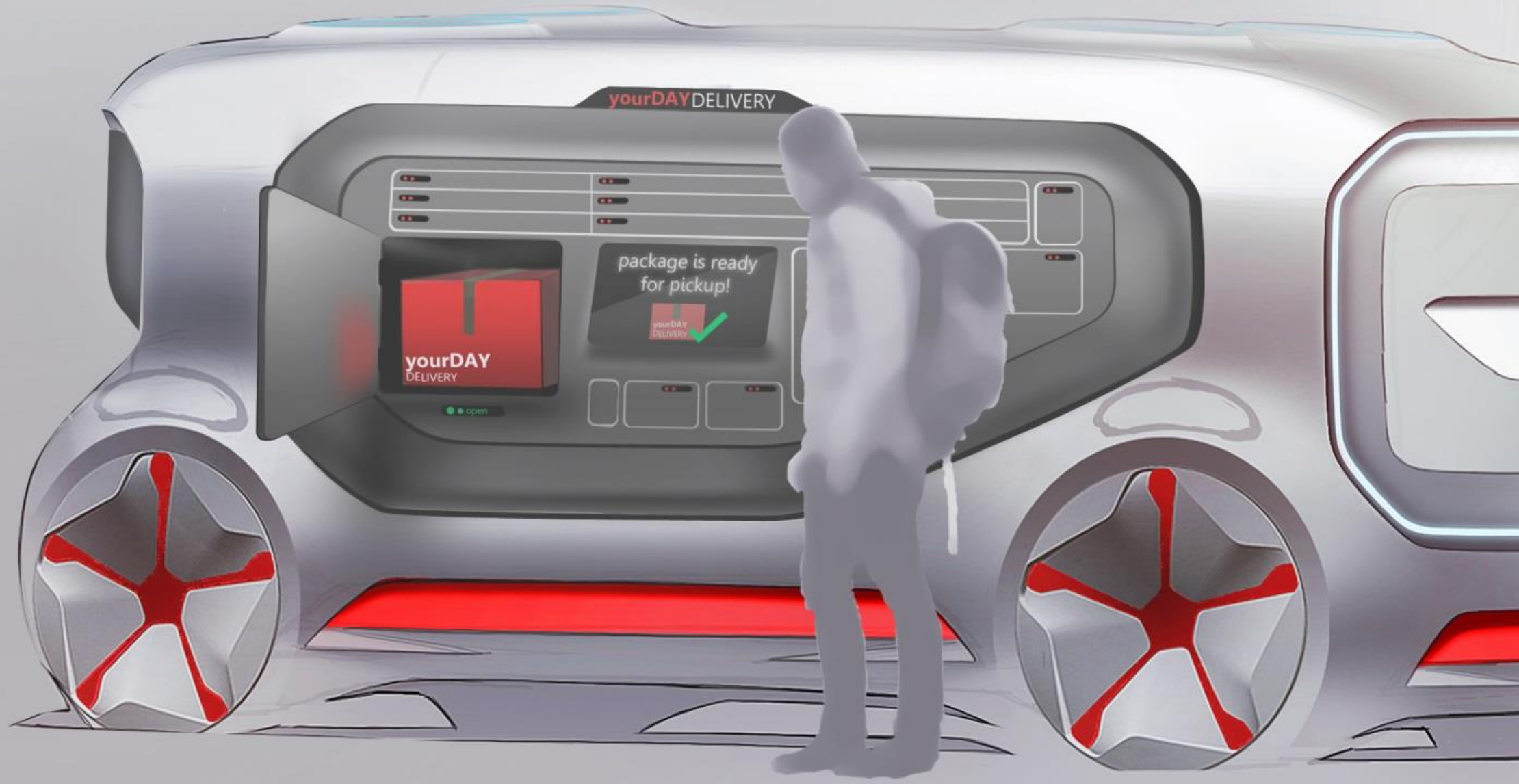


Sedric Racer



Sedric Urban Shuttle

Sedric Delivery Van / Mobile Mailbox Stations



Sedric Long-haul Truck

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Vision: Mobility for ALL,

at the push of a button

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Impact of Mobility-as-a-Service on Cities

Model City Characteristics

- Densely populated urban area
- 5.5 million inhabitants
- 1 million privately owned vehicles
- 28,000 taxis
- 8,000 km of roadways
- 600 major intersections
- Well developed public transportation systems (rail and bus)
- High congestion level of 33%
- 8,000 car accidents per year
- High land values of $7,000/m^2

Note: City modeled on Singapore, New York City, London, and others
Source: World Economic Forum; BCG analysis, Singapore MOT

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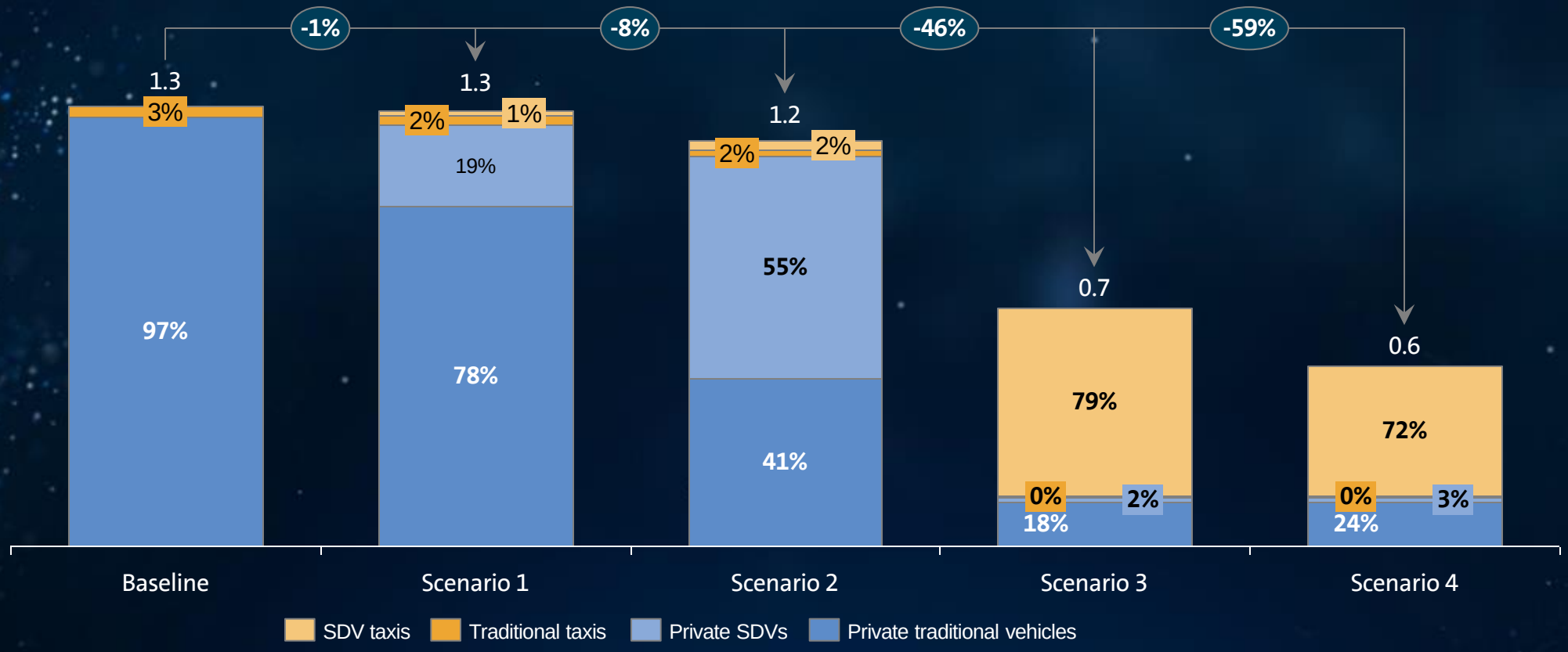
Key characteristics		Scenario 1	Scenario 2	Scenario 3	Scenario 4
1 City policy		No policy incentives or disincentives for SDV use	City incentivizes the purchase of private SDVs	City disincentivizes private vehicle ownership	City disincentivizes private car owner-ship, encourages ride-sharing
2 Sharing economy model		Private vehicle sharing increases, but less than 5% of private vehicles are shared	Private vehicle sharing increases, over 5% of private vehicles are shared	SDV taxis are shared by all city travelers	SDV taxis and rides taken in SDV taxis are shared by all city travelers
3 SDV share of new vehicle sales		SDVs capture 25% of new vehicle sales	SDVs capture 75% of new vehicle sales	Over 90% of new vehicle sales are SDV	Over 90% of new vehicle sales are SDV
4 Electric engine share of new vehicle sales		25% of new vehicle sales are electric	50% of new vehicle sales are electric	100% of new vehicle sales are electric	100% of new vehicle sales are electric
5 Predominant vehicle ownership model		Private vehicle ownership	Private vehicle ownership	Fleet ownership of SDV taxi	Fleet ownership of shared ride SDV taxi
6 Impact on public transportation		SDV taxi replaces very limited low capacity bus routes	SDV taxi replaces some low capacity bus routes	SDV taxi replaces one fifth of bus routes	SDV taxi replaces one third of bus routes and some rail travel

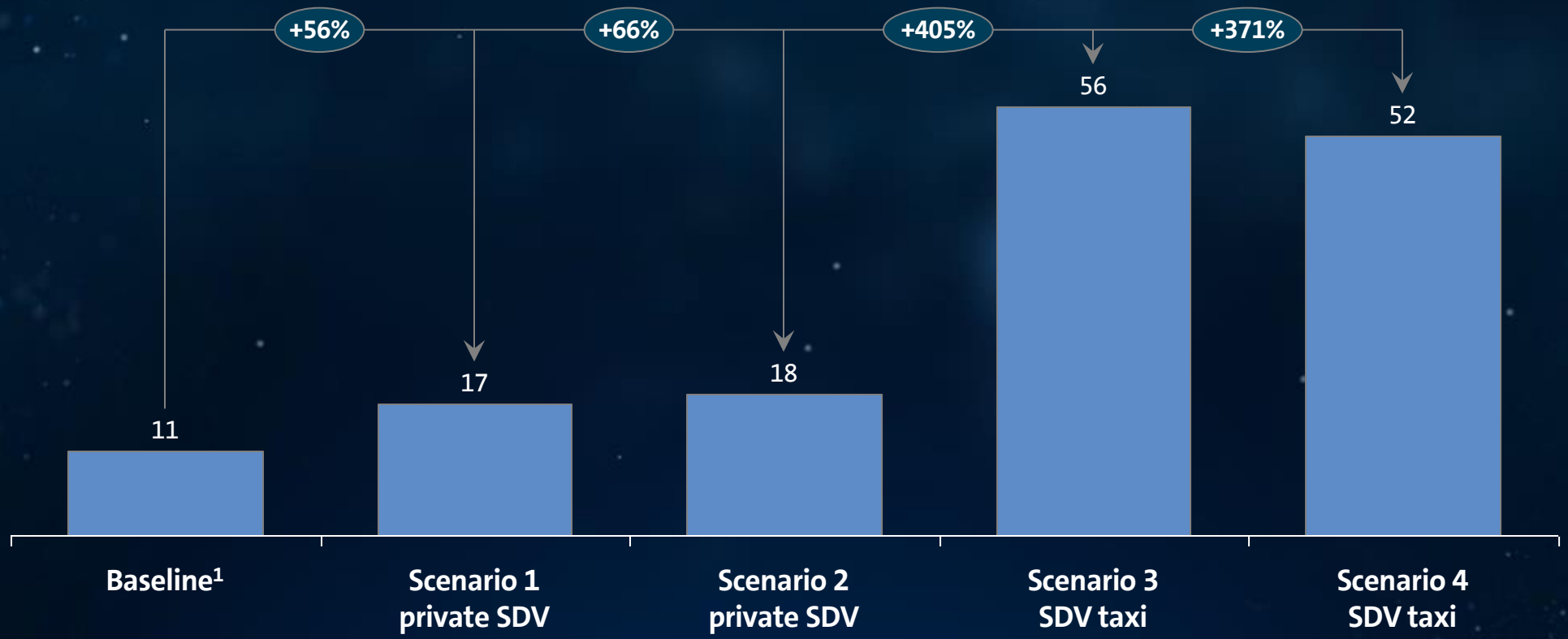
Source: World Economic Forum; BCG analysis

Total vehicle population in year 10 (millions of vehicles[1])



1.Vehicle population is the sum of all private vehicles and taxis
Source: World Economic Forum; BCG analysis

Vehicle utilization in year 10 ('000 km/year)



1.Baseline is annual average private traditional vehicle distance traveled in year 0
Source: World Economic Forum; BCG analysis

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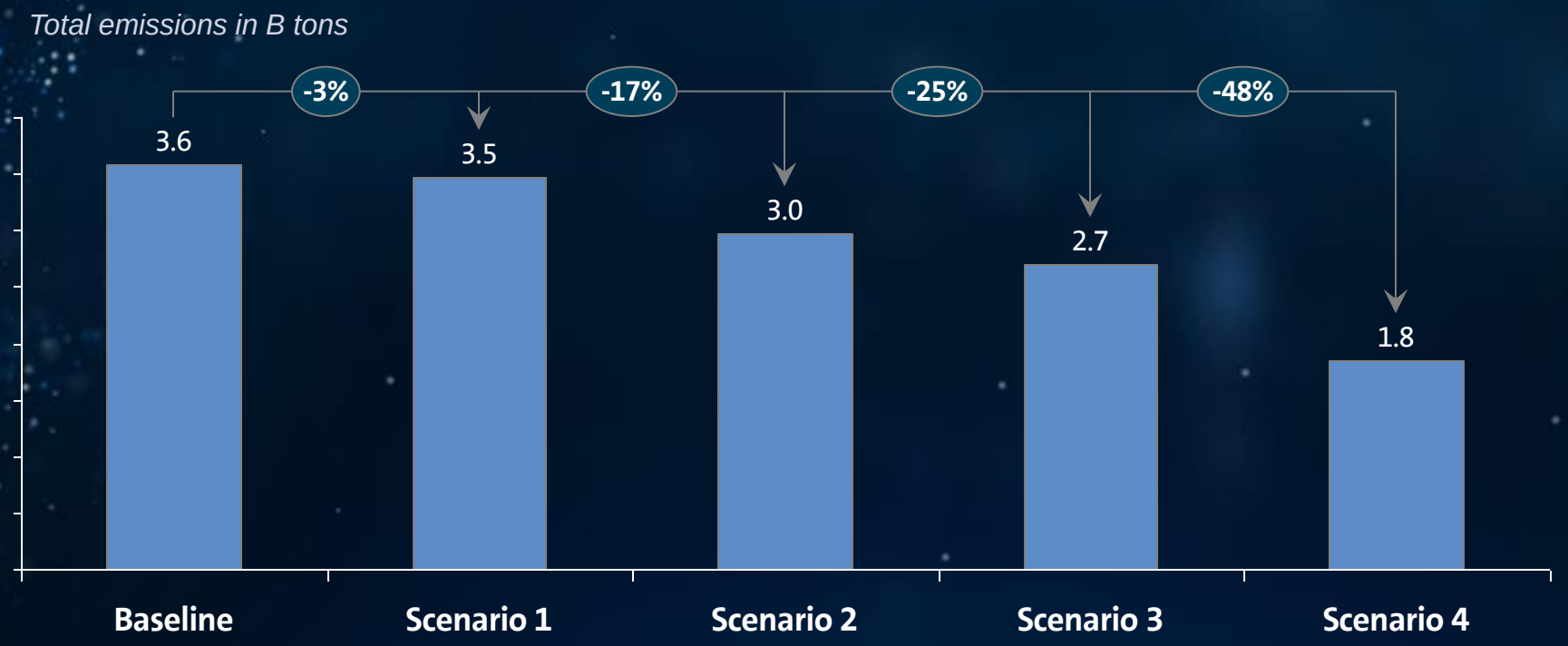
Total emissions



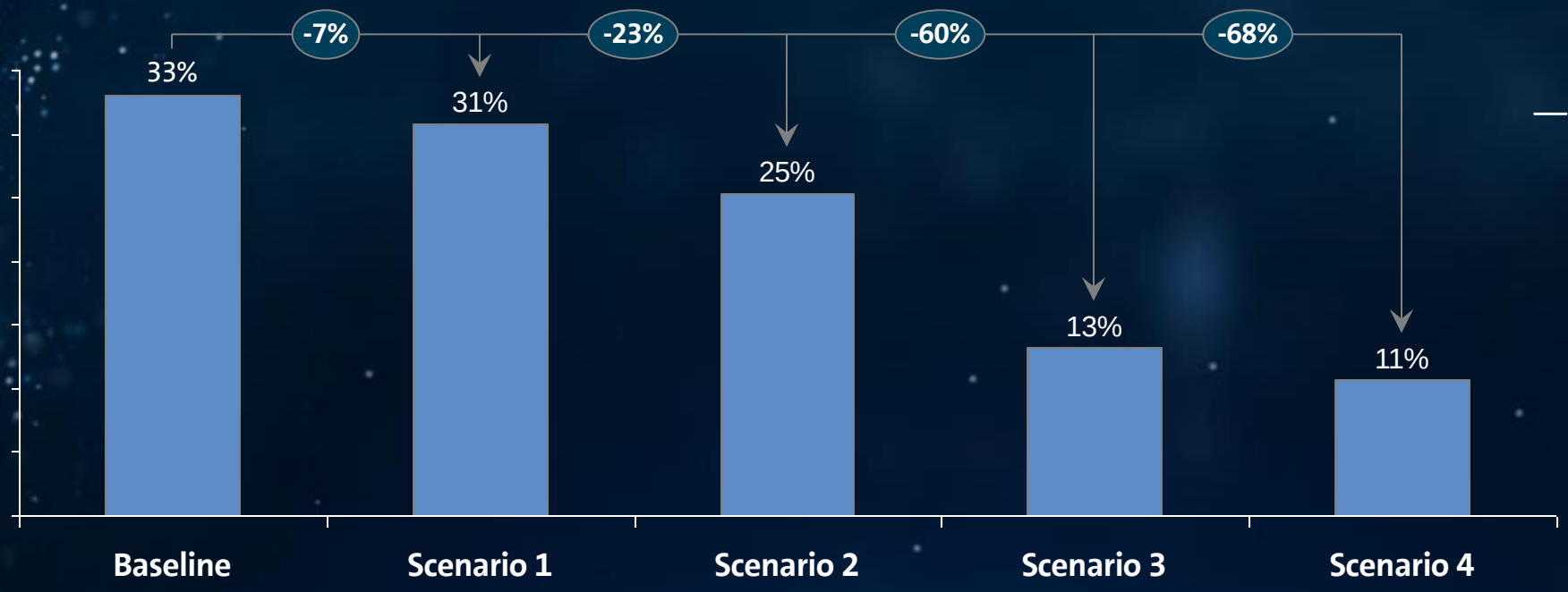
Rationale

New level of emissions driven by

— Change in vehicle hours driven
— Fuel efficiency of self-driving vehicles
— Increasing share of electric vehicles with low emissions

Note: In year 10
Source: World Economic Forum; BCG analysis

Congestion development



Rationale

— Congestion due to recurrent traffic fully depends on size of vehicle population
— Lower congestion due to decrease in vehicle population

Note: In year 10
Source: World Economic Forum; BCG analysis

Lives can be saved over 10 year time period

Rationale

- 90% of accidents occur due to human error, 95,000 accidents in total over 10 years in baseline
- Decrease in all types of accidents proportional to decrease in occurrence of human error
- Occurrence of human error decreases with increasing SDV penetration
- Three types of accidents considered:
  - Fatal accidents
  - Injury accidents
  - Property damage accidents

Source: World Economic Forum; BCG analysis
World Economic Forum; BCG analysis

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Mobility-as-a-Service in Numbers

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Self-Driving Vehicles driving will be the game changer!

190.900.000
cars will be connected with the internet in 2021

42%
of the auto fleet in Germany will be autonomous in 2035

90%
of the crashes can be eliminated through autonomous driving

2/3
of participants of a German survey would rather travel by an autonomous vehicle (for long distances)

$77bn
revenue will be generated with autonomous vehicles in 2035, after **$41.7bn** in 2025

5% share of autonomous cars can reduce traffic congestion significantly

Source: ISI Evercore; Autonomous on Autobahn, 12/2017

Self-Driving Vehicles | Market analysis – Volume forecast cumulative 2015-2030

	McKinsey&Company	berylls STRATEGY ADVISORS	RethinkX
Limitations		▪ Only MaaS in urban areas, Focus NAR & EU	▪ Only MaaS, Focus US market
General assumptions	▪ Level 4 SDV likely available by the mid 2020s	▪ Definition of endgame scenarios low, medium and high for 2035 based on modal split of 2015	▪ High disruptive potential of SDV and fast expansion due to network effect
SDV utilization	▪ n/a	▪ 70-80% rides with passengers	▪ 40% MaaS vehicle utilization, 10 times higher than individual owned vehicle
SDV lifespan	▪ n/a	▪ Ø-Vehicle km p.a.: 100,000, Life span 2-3 years	▪ MaaS vehicles will drive 500,000 miles up to 1 mn over their lifetimes
Costs	▪ Consumer Cost pooled SDV taxi in 2025 $0.17-0.29 per mile	▪ n/a	▪ MaaS cost-per-mile of 15.9 ct (central case), 6.8 ct (upside case)

Cumulative new SDV sales
2015-2030

Sources: Online Research, RethinkX, McKinsey&Company, Berylls Strategy Advisor, P3 analysis

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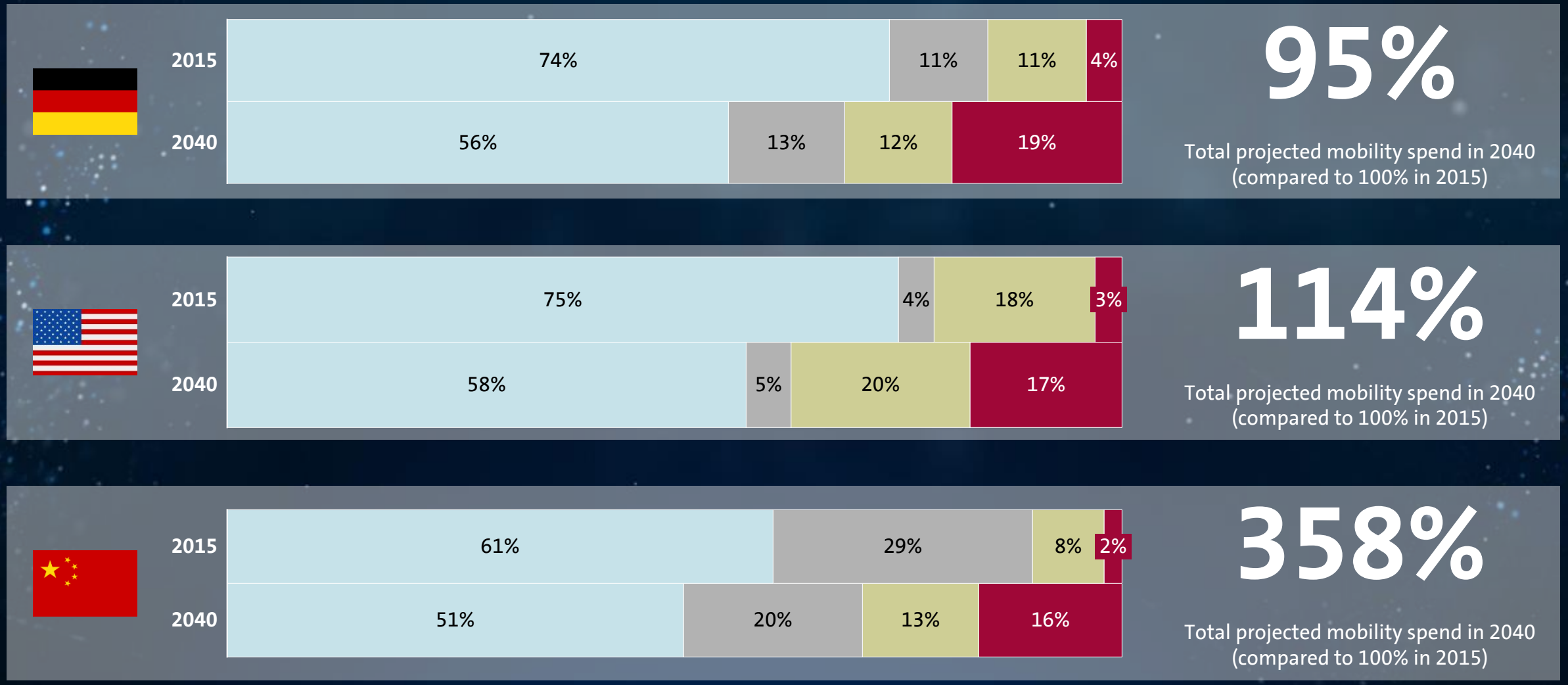
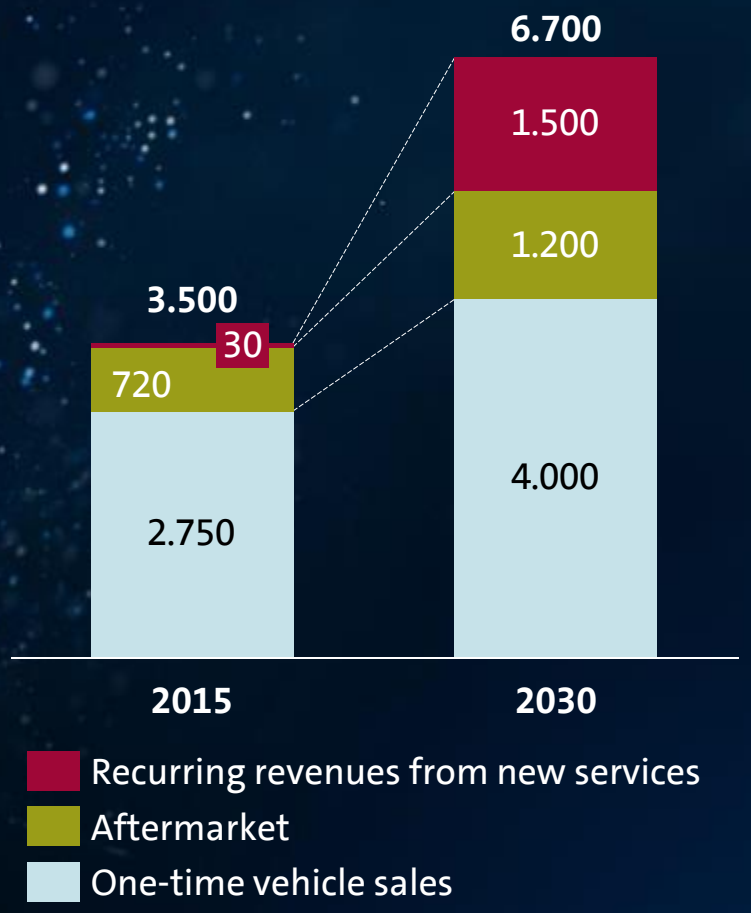
Mobility-as-a-Service will grow dramatically until 2040



Source: Oliver Wyman; http://www.oliverwyman.de/content/dam/oliver-wyman/global/en/2016/nov/Mobility2040ReportWeb.pdf

Revenue in the **automotive industry**



will **grow** from

$3,500 to $6,700bn

RECURRING REVENUES FROM NEW SERVICES

- shared mobility – e.g. car sharing, ride hailing, etc.
- Data connectivity services – e.g. apps, remote services, etc.

$30bn  **$1,500bn**

Source: McKinsey; https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/disruptive-trends-that-will-transform-the-auto-industry

$39.9bn

did companies invest into the "mobility eco system" globally[1]

71%

of the ride hailing investments are concentrated on **Uber** and **Didi**[1]

Source: [1]Berylls; The (r)evolution of urban mobility; 07/2017 [2]Berylls; Electric robotaxis – the "silver bullet" for urban mobility? [3]ETH Zürich; Cost-based Analysis of Autonomous Mobility Services; 05/2017
[4]McKinsey & Company; An integrated perspective on the future of mobility; 10/2016

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MaaS SDVs will solve **current and future problems** of our cities

$23.000.000.000

does congestion cost the city of Los Angeles every year[4]

30%

will cities become more dense in average over the next 15 years[4]

2,9m m²

of parking space could be used otherwise through MaaS[2]

200.000

private cars could be replaced with autonomous shared vehicles in Munich[2]

18.000

autonomous shared vehicles could replace 100% of the daily individual motorized transport in the inner city of Munich[2]

Source: [1]Berylls; The (r)evolution of urban mobility; 07/2017 [2]Berylls; Electric robotaxis – the "silver bullet" for urban mobility? [3]ETH Zürich; Cost-based Analysis of Autonomous Mobility Services; 05/2017
[4]McKinsey & Company; An integrated perspective on the future of mobility; 10/2016

MaaS SDVs will **reduce** the **costs** for **mobility significantly**

85%

utilization can be achieved with shared autonomous vehicles in Munich[2]

€0,16

would one customer km cost in a shared autonomous vehicle in Munich[2]

-85%

of the costs for a taxi ride per km can be reduced through the shift towards autonomous technology[3]

+20 to 50%

could travel grow within a seamless mobility system – because it is cheap and easy[4]

Source: [1]Berylls; The (r)evolution of urban mobility; 07/2017 [2]Berylls; Electric robotaxis – the "silver bullet" for urban mobility? [3]ETH Zürich; Cost-based Analysis of Autonomous Mobility Services; 05/2017
[4]McKinsey & Company; An integrated perspective on the future of mobility; 10/2016

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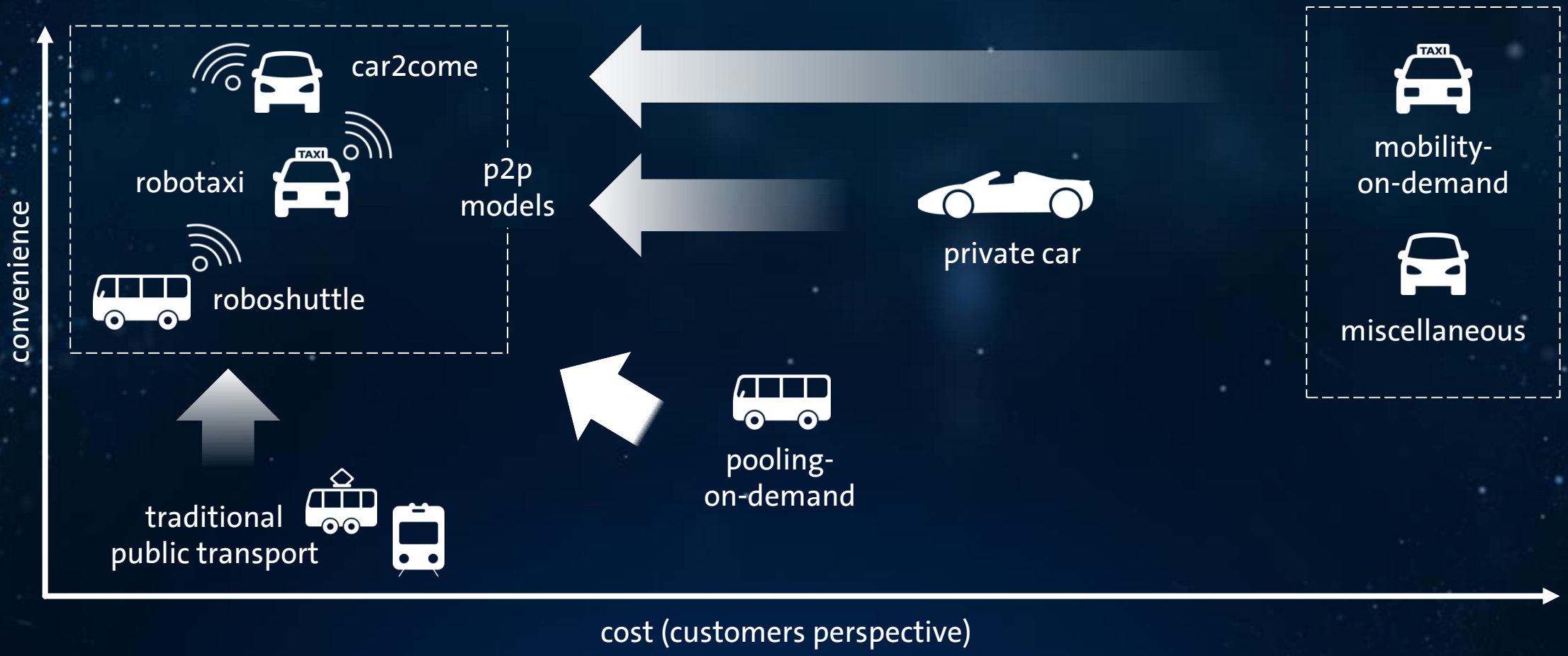
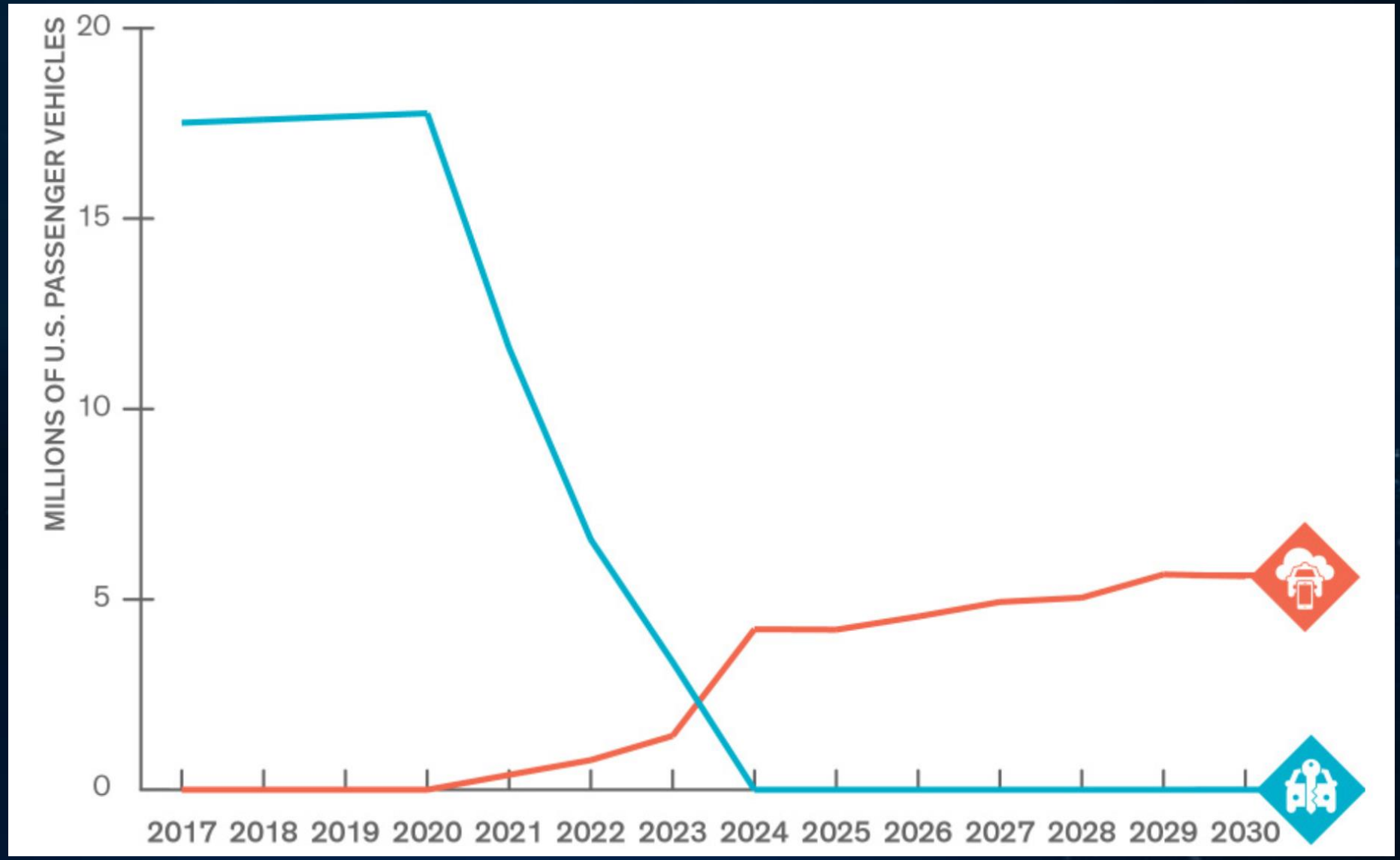
Shared mobility services will **cost as little** as public transport and deliver **convenience** like a private car



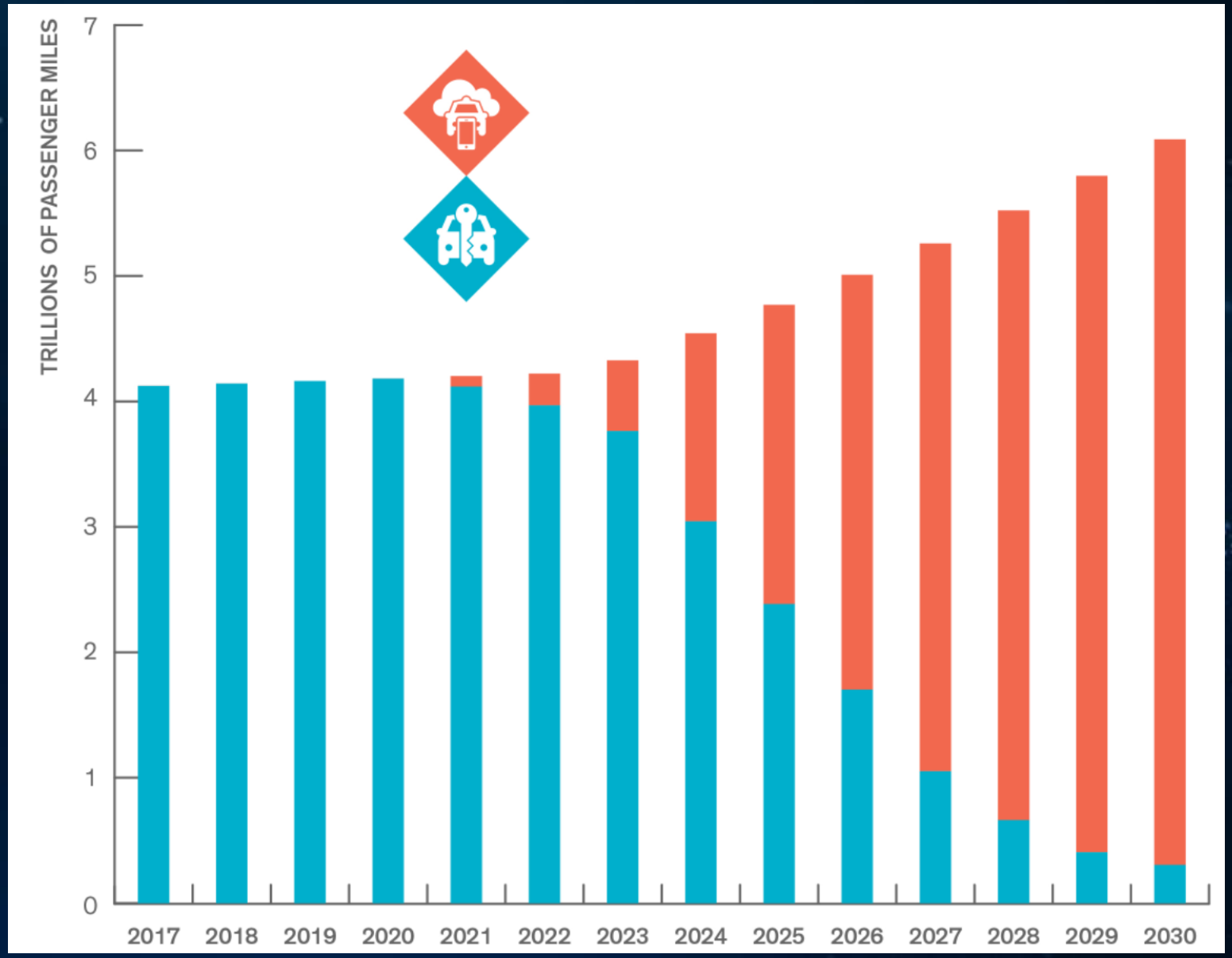
Source: Berylls; The (r)evolution of urban mobility; 07/2017

ICE vs. MaaS: Projected Trends in Annual Sales (U.S.)



Source: Rethink X Study 2017

Speed of MaaS Adoption (U.S.)



Source: Rethink X Study 2017

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2D/3D Mobility-as-a-Service

ITALDESIGN

Source: http://bit.ly/2yVBbPD

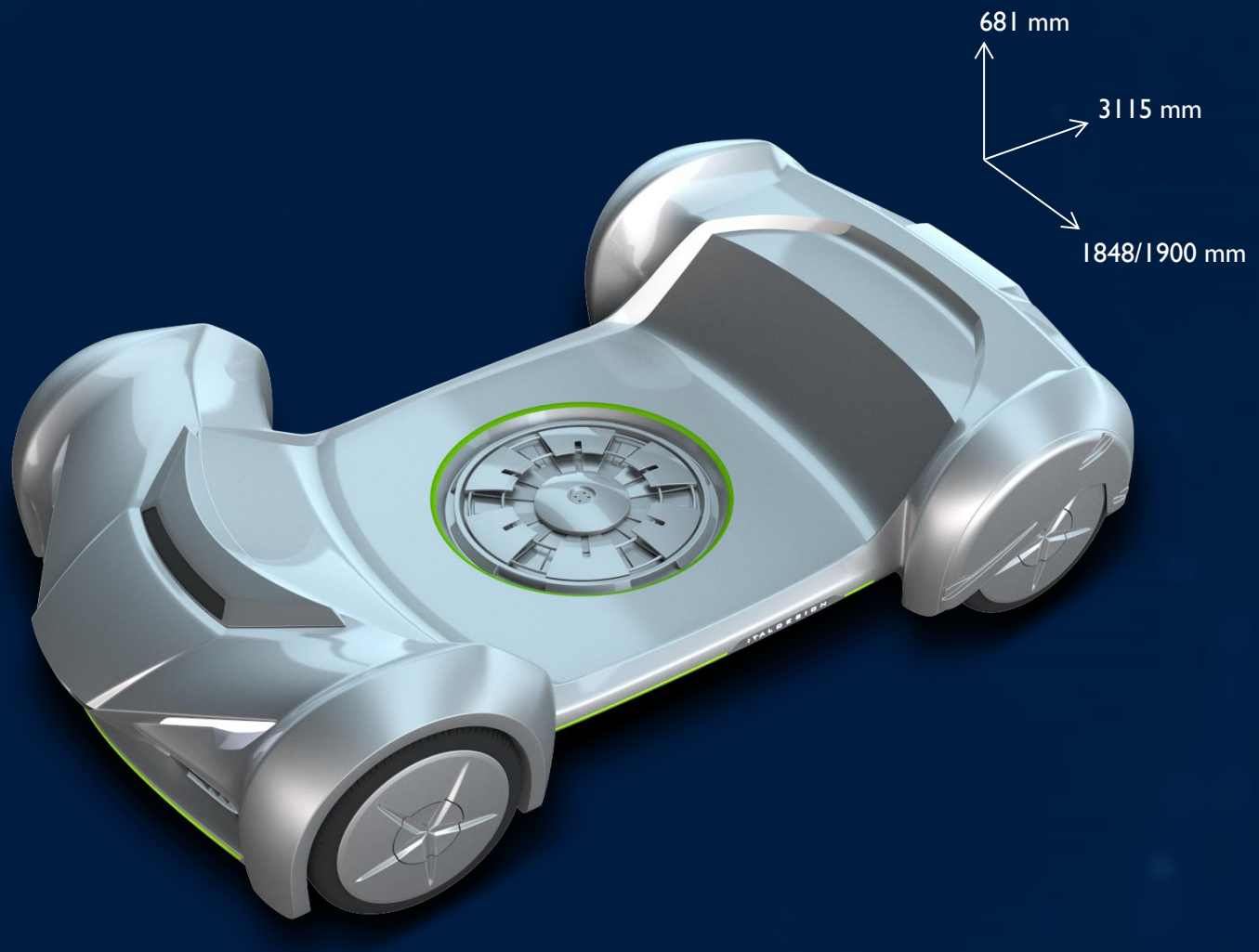
Source: http://bit.ly/2gUOnKe

ITALDESIGN

GROUND MODULE

Electric platform with unmanned SAE 5 level autonomous driving system.

Carries and transports Passenger Cell on the road safely.



ITALDESIGN

CAPSULA

Passive, not self-propelled, fully connected, double-seater compartment in new material with a kerb weight 200 kg, shared, but highly individual (ambient, shift wear etc.).

ITALDESIGN

AIR MODULE

Electric platform, unmanned SAE 5 autonomous flying EVTOL – Vertical Take-Off and Landing - granting the Passenger Cell to fly in the 'City Sky'.

Equipped with FAA and EASA compliant 4+4 coupled contra-rotating rotors.


AIRBUS
HYPERLOOP
TRANSPORTATION TECHNOLOGIES
POP.UP

Together towards a sustainable, electric self-driving mobility future...

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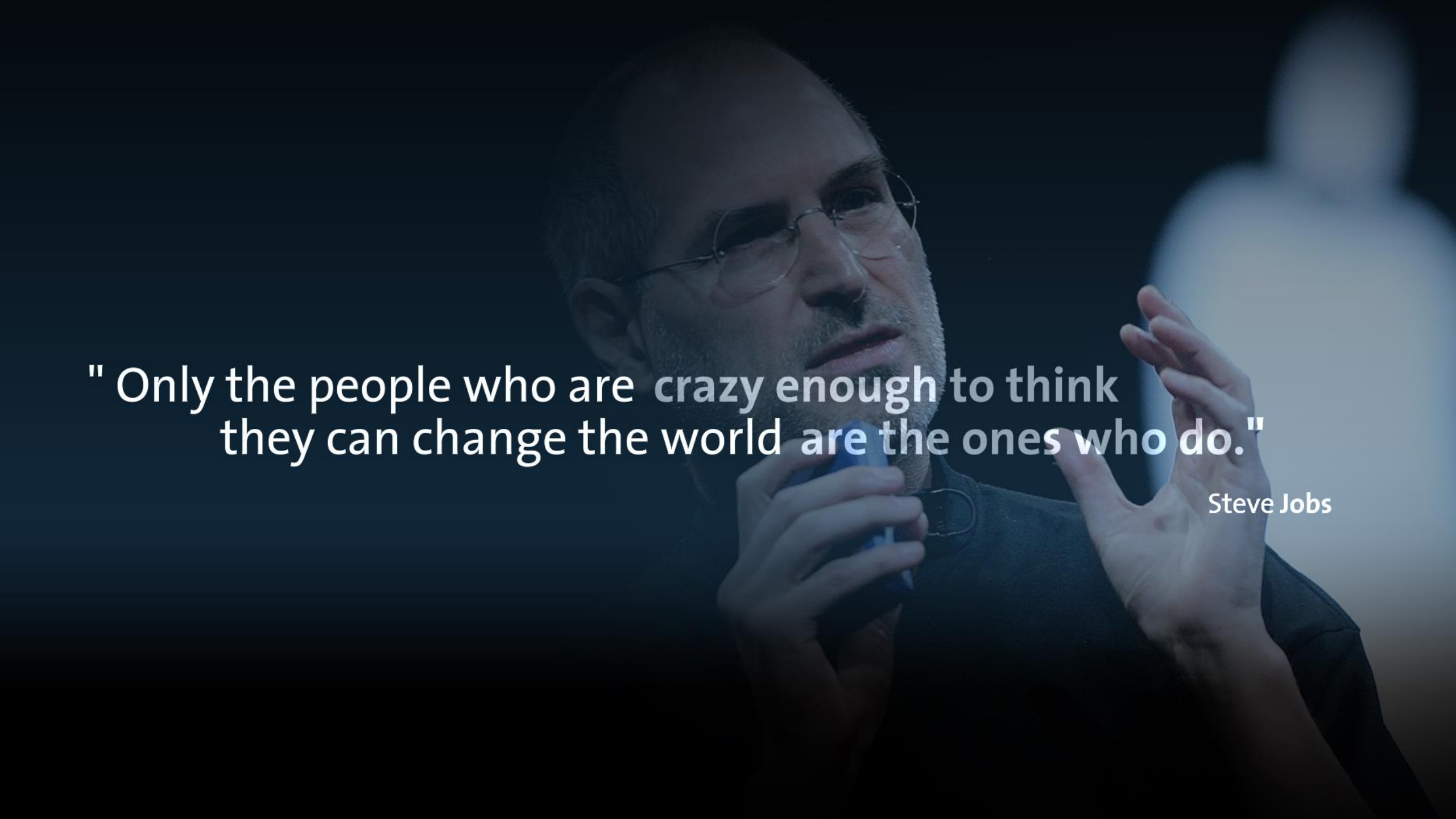
AURORA


MOIA
MO IA1E


PAPIER
ZIGARREN
TABAK
MOIA
MO IA1E


" Only the people who are crazy enough to think
they can change the world are the ones who do."
Steve Jobs

WE are the Generation,

That is reinventing the Automobile und Mobility