

# Sensors for Robotic Mobility 2020

Market and Technology  
Report - Sample

# A COMPLETE SET OF PRODUCTS & SERVICES TO ANSWER YOUR NEEDS



## YEARLY REPORTS

### Insight

- › Yearly reports
- › Market, technology and strategy analysis
- › Supply chain changes analysis
- › Reverse costing and reverse engineering

### Format

- › PDF files with analyses
- › Excel files with graphics and data

### Topics

- › Photonics, Imaging & Sensing
- › Lighting & Displays
- › Power Electronics & Battery
- › Compound Semiconductors
- › Semiconductor Manufacturing and Packaging
- › Computing & Memory

**115+ reports per year**

## QUARTERLY MONITORS

### Insight

- › Quarterly updated market data and technology trends in units, value and wafer
- › Direct access to the analyst

### Format

- › Excel files with data
- › PDF files with analyses graphs and key facts
- › Web access (to be available soon)

### Topics

- › Advanced Packaging
- › Application Processor
- › DRAM
- › NAND
- › Compound Semiconductor
- › CMOS Image Sensors
- › Smartphones

**7 different monitors quarterly updated**

## WEEKLY TRACKS

### Insight

- › Teardowns of phones, smart home, wearables and automotive modules and systems
- › Bill-of-Materials
- › Block diagrams

### Format

- › Web access
- › PDF and Excel files
- › High-resolution photos

### Topics

- › Consumer: Smartphones, smart home, wearables
- › Automotive: Infotainment, ADAS, Connectivity

**175+ teardowns per year**

## CUSTOM SERVICE

### Insight

- › Specific and dedicated projects
- › Strategic, financial, technical, supply chain, market and other semiconductor-related fields
- › Reverse costing and reverse engineering

### Format

- › PDF files with analyses
- › Excel files with graphics and data

### Topics

- › Photonics, Imaging & Sensing
- › Lighting & Displays
- › Power Electronics & Battery
- › Compound Semiconductors
- › Semiconductor Manufacturing and Packaging
- › Computing & Memory

**190 custom projects per year**



- 1. To provide a scenario for sensors within the dynamics of the robotic vehicle market**
  - Sensor semiconductor ASP forecast, revenue forecast, volume shipments forecast
  - Sensor systems ASP forecast, revenue forecast, volume shipments forecast
  - Application focus on the sensor suite : Lidar, Radar, Cameras, IMU, GNSS
  
- 2. To provide in-depth understanding of the ecosystem & players.**
  - Who are the players / how does the robotic vehicle ecosystem relates to automotive ecosystem
  - Who are the key suppliers to watch and which technology do they .
  
- 3. To provide key technical insight & analysis about future technology trends and challenges.**
  - Key technology choices
  - Technology dynamics
  - Emerging technologies and roadmaps

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# METHODOLOGIES & DEFINITIONS

Yole's market forecast model is based on the matching of several sources:

**Comparison with existing data**  
**Monitoring of corporate communication**  
**Using other market research data**  
Yole analysis (consensus or not)

**Comparison with prior Yole reports**  
Recursive improvement of dataset  
Customer feedback

Preexisting information

**Top-to-bottom approach**  
Aggregate of market forecasts  
@ System level



**Market**  
Volume (in Munits)  
ASP (in \$)  
Revenue (in \$M)

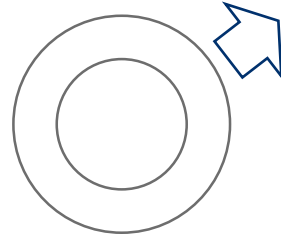
**Bottom-up approach**  
Ecosystem analysis  
Aggregate of all players' revenue  
@ System level



**Primary data**

- Reverse costing
- Patent analysis
- Annual reports
- Direct interviews

**Top-to-bottom approach**  
Aggregate of market forecast  
@ Semiconductor device level

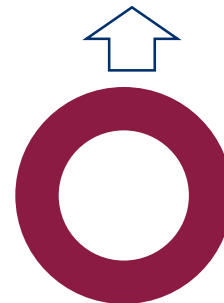


**Bottom-up approach**  
Ecosystem analysis  
Aggregate of key players' revenues  
@ Semiconductor device level



**Secondary data**

- Press releases
- Industry organization reports
- Conferences



**Semiconductor foundry activity**  
Capacity investments and equipment needs

Information Aggregation

# ABOUT THE AUTHOR

## Biography & contact



### **Pierre Cambou**

Pierre Cambou MSc, MBA, is a Principal analyst in the Photonic and Display Division at Yole Développement (Yole). Pierre's mission is dedicated to imaging related activities by providing market & technology analyses along with strategy consulting services to semiconductor companies. He has been deeply involved in the design of early mobile camera modules and the introduction of 3D semiconductor approaches to CMOS Image Sensors (CIS). Pierre has a broad understanding of the various markets and technologies associated with CIS, having obtained 6 patents in this field and founded one startup company in 2012.

At Yole, Pierre is responsible for the CIS Quarterly Market Monitor while he has authored more than 15 Yole Market & Technology reports. Known as an expert in the imaging industry, he is regularly interviewed and quoted by leading international media.

Previously, Pierre held several positions at Thomson TCS, which became Atmel Grenoble (France) in 2001 and e2v Semiconductors (France) in 2006. In 2012, he founded Vence Innovation, later renamed Irlynx (France), to bring to market an infrared sensor technology for smart environments.

Pierre has an Engineering degree from Université de Technologie de Compiègne (France) and a Master of Science from Virginia Tech. (VA, USA). Pierre also graduated with an MBA from Grenoble Ecole de Management (France).

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# COMPANIES CITED IN THIS REPORT

A3, Aeye, Ambarella, Ams, Aptiv, Allied Vision, Arbe Robotics, Asc, Blackmore, Basler, Bosch, Cepton, Continental, Cruise, Delphi, Denso Ten, Didi, Easy Miles, Flir, Furuno, General Motors, Gentex, Grab, Geely, Hella, Hexagon, Hokuyo, Honeywell, Ibeo, Infineon, Innoviz, Intel, Ixblue, Joby, Kalray, Konica Minolta, Kittyhawk, KVH, LeddarTech, Lillium, Luminar, Lyft, Magna, Metawave, Mitsubishi Electric, Mobileye, Murata, Navtech, Navya, Neptec, Novatel, Nuotomy, Nvidia, NXP, Oculii, Oryx, Physical Logic, Pioneer, Prophesee, Quanergy, Renesas, Robosense, Sensible 4, Sensoror, Sick, Sony, Socionext, STMicroelectronics, Strobe, TDK, Texas Instruments, Telit, Terrafugia, Tetravue, Toshiba, Trieye, Trimble, Uber, Ublox, Velodyne Lidar, Valeo, Vayyar, Waymo, Wisk, Xenomatix, Xillinx, Zoox and more.



# Report Sample

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# GLOBAL TECHNOLOGY ROADMAP

Empires are built upon resources and technologies

£

\$

¥

Energy



Telecom



City transport



Long distance



EHANG

1750

+120 years

1870

+80 years

1950

+50 years

2000

+30 years

2030

+20 years

2050

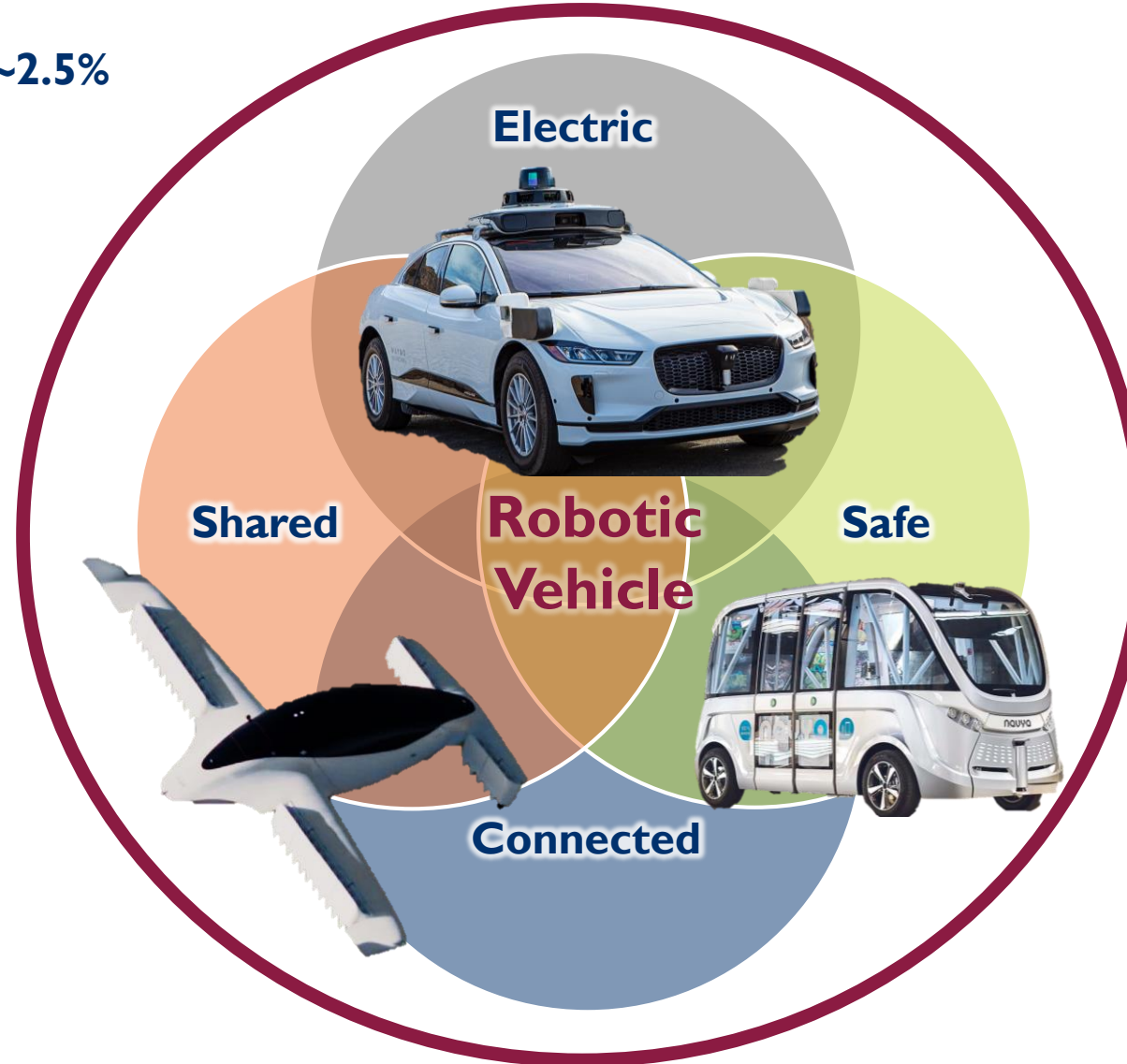
# ROBOTIC TRANSPORTATION - KEY DRIVERS



**World GDP is growing ~2.5%  
so will human mobility**

Current means of transportation have **5 major limitations :**

1. Pedestrian safety
2. Public transport efficiency & cost
3. Car congestion & cost of ownership
4. Air transport city connectivity
5. CO2 emissions for all



Robotic transportation will embrace current transportation mega trends and beat current paradigm on all KPIs

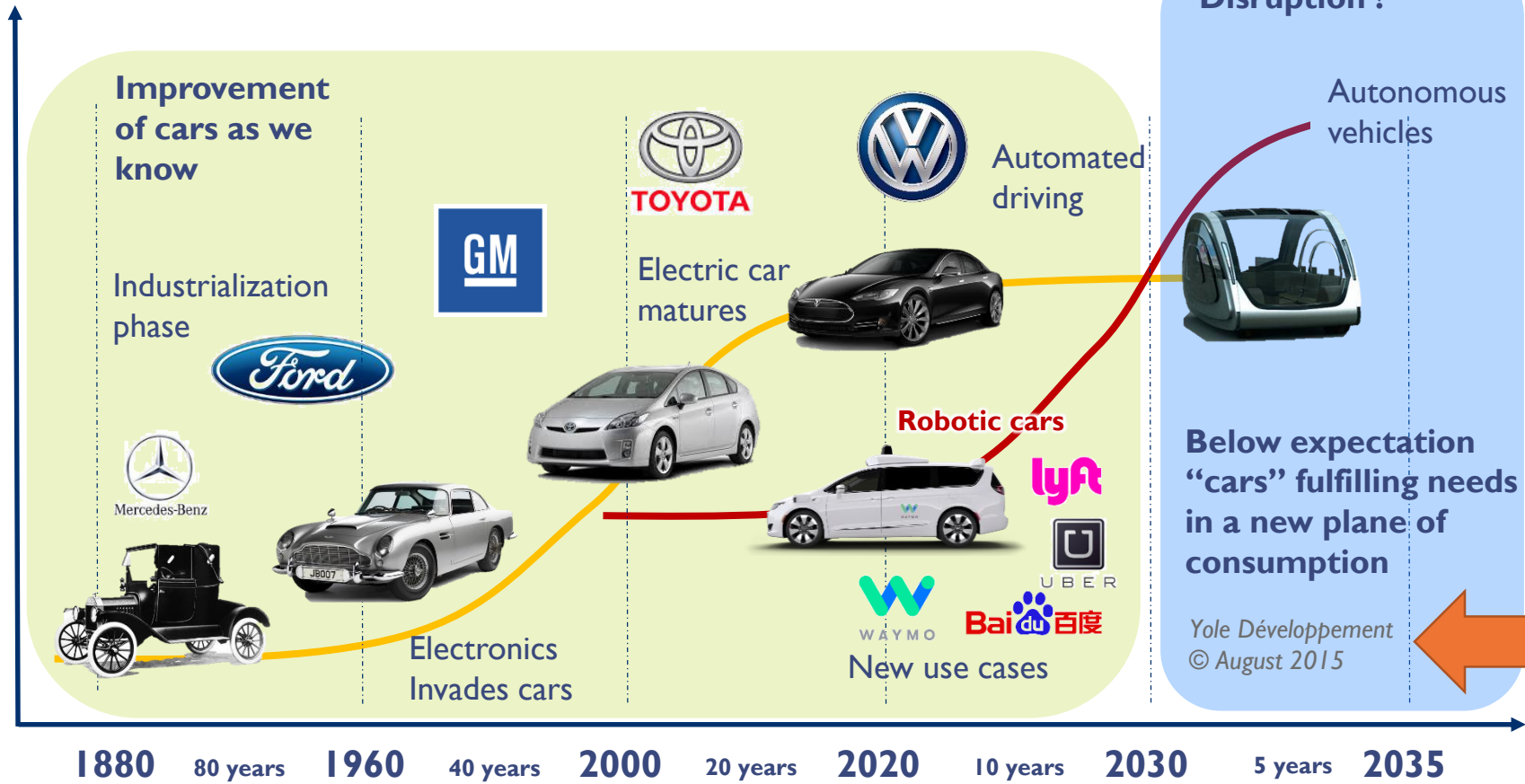
- Distance serviced
- Time & efficiency
- Cost of travel
- Safety of travel and surrounding peoples
- Emission footprint & Intensity

# AUTONOMOUS VEHICLES: THE DISRUPTION CASE

Two distinctive paths for autonomous cars

2020 should see the initial deployment of commercial activities

Technology x market penetration



Acceleration : The speed of technology change doubles every technology shift

# ROBOTICS SEGMENTATION



Yole Développement © March 2020



	Flying	Floating	4+ Legged	2-Legged	6+ Wheeled	4+ Wheeled	2-Wheeled	Arms	Head
Defense									
Industrial									
Security									
Medical									
Transport			<b>Robotic Mobility</b>						
Commercial									
Consumer									

# ROBOTIC TRANSPORT SEGMENTATION



Yole Développement © March 2020



Flying

Floating

4+ Legged

2-Legged

6+ Wheeled

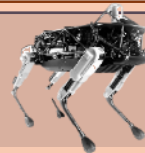
4+ Wheeled

2-Wheeled

Arms

Head

Military transport



Transport of goods



Transport of goods not included

Mass transportation



Human mobility is the main focus of this report

On demand transportation



Personal transportation

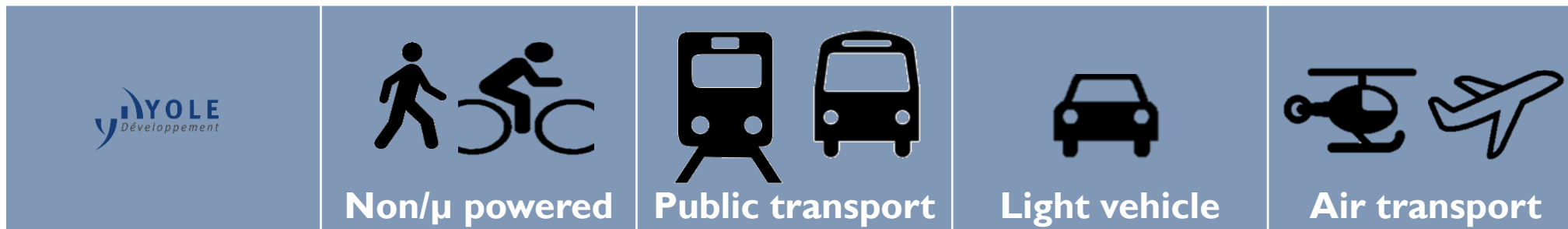


Toys

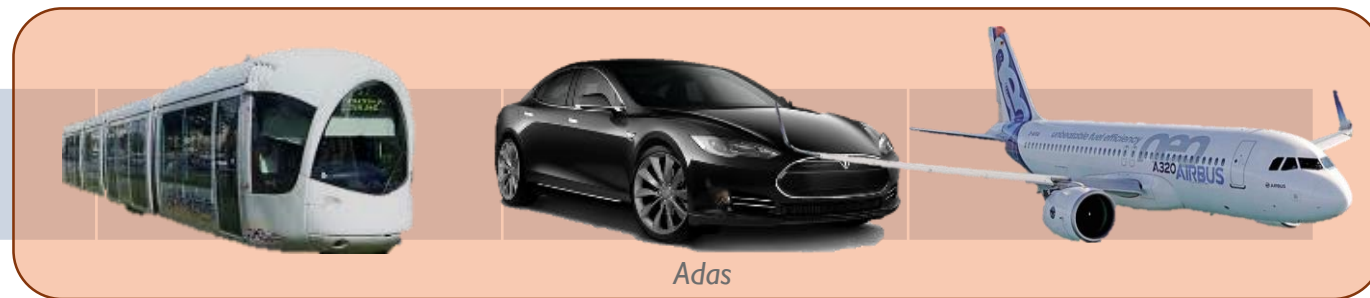


# HUMAN TRANSPORTATION

From automated to robotic



Automation of current transport vehicles



Adas

New robotic transportation



Pods



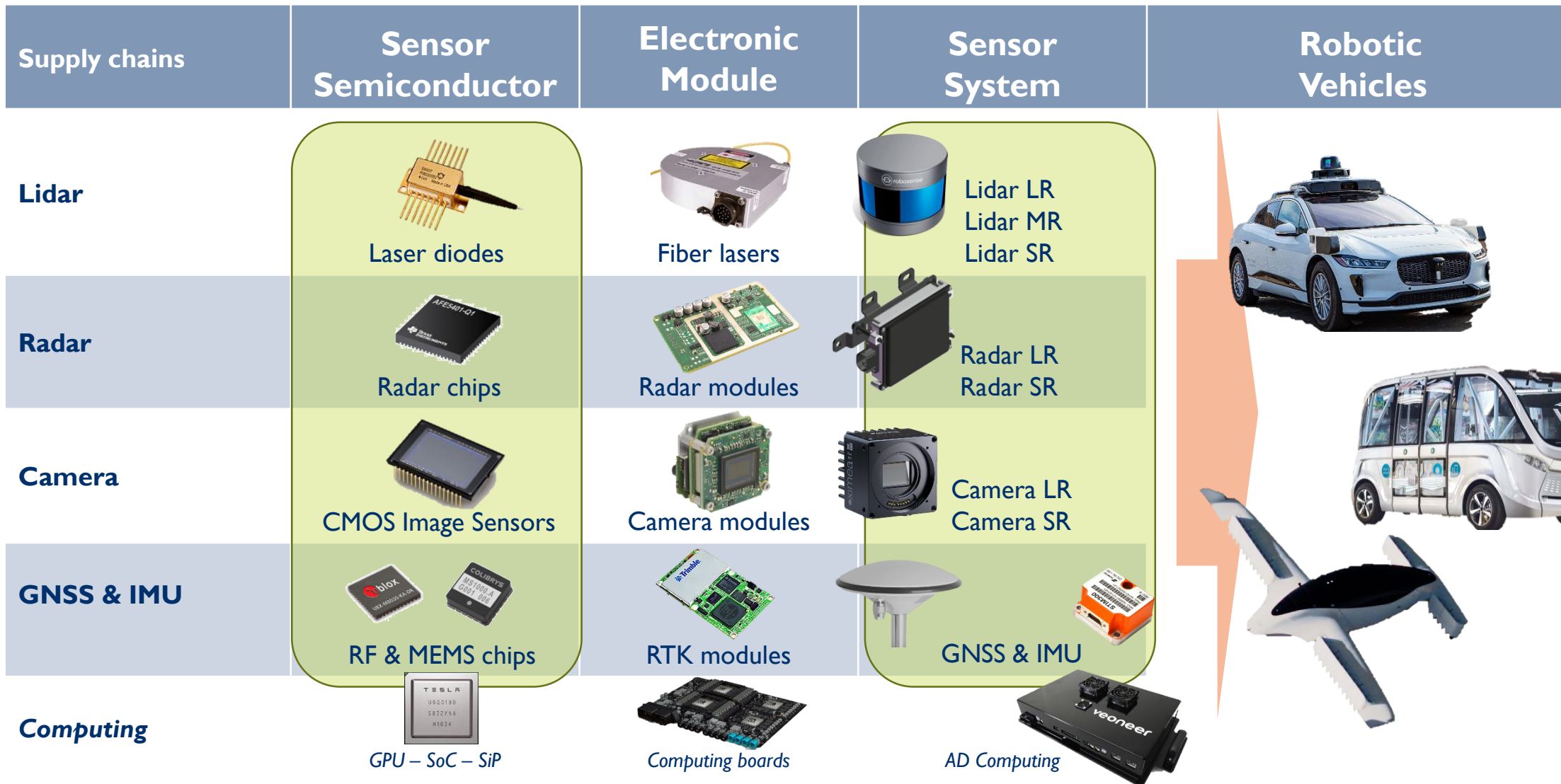
Shuttles

Robo-taxi

Urban air mobility

# SENSORS FOR ROBOTIC TRANSPORTATION

From semiconductor devices to vehicles





# WHAT WE GOT RIGHT, WHAT WE GOT WRONG

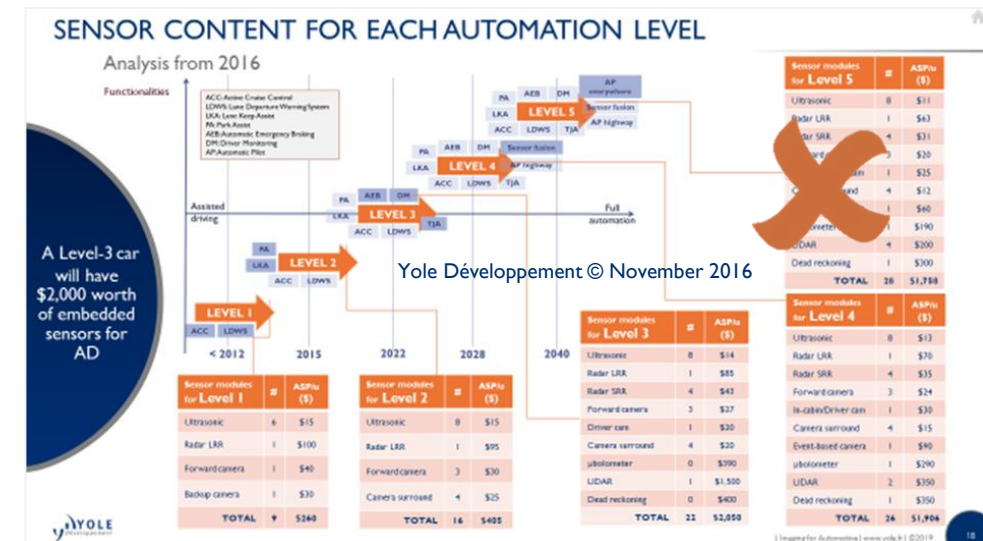
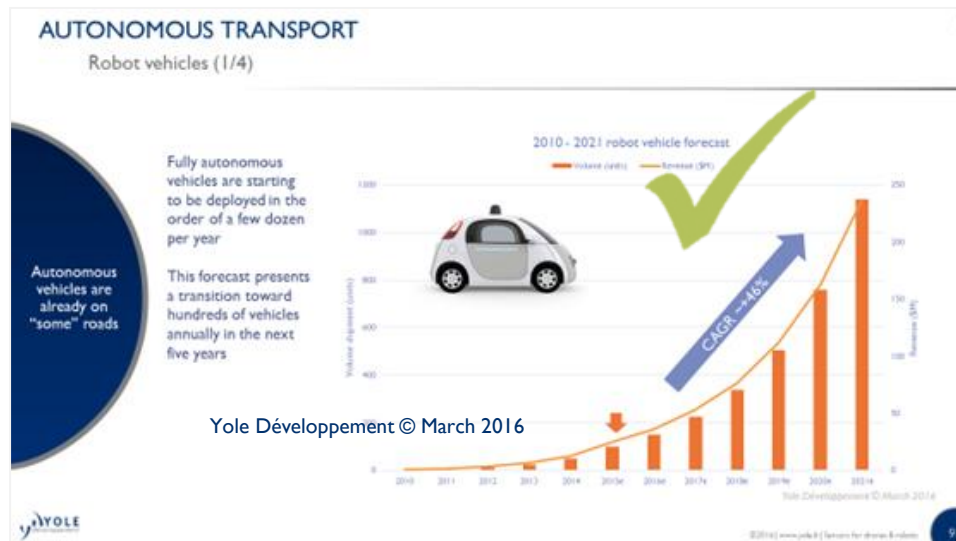
## Technology and market forecast - challenge

### What we got right

- Reaching production >1,000 units in 2020
- Lidar, Radar, Camera, GNSS, IMU sensor set
- Addition of thermal cameras starting 2020
- Importance of eVTOL urban air mobility

### What we got wrong

- E.Hertzberg accident slowed down robotic vehicle effort
- ADAS based autonomy will take much longer than initially expected
- The SAE levels of autonomy is almost useless, intermediary levels 2+ and 2++ are now being introduced



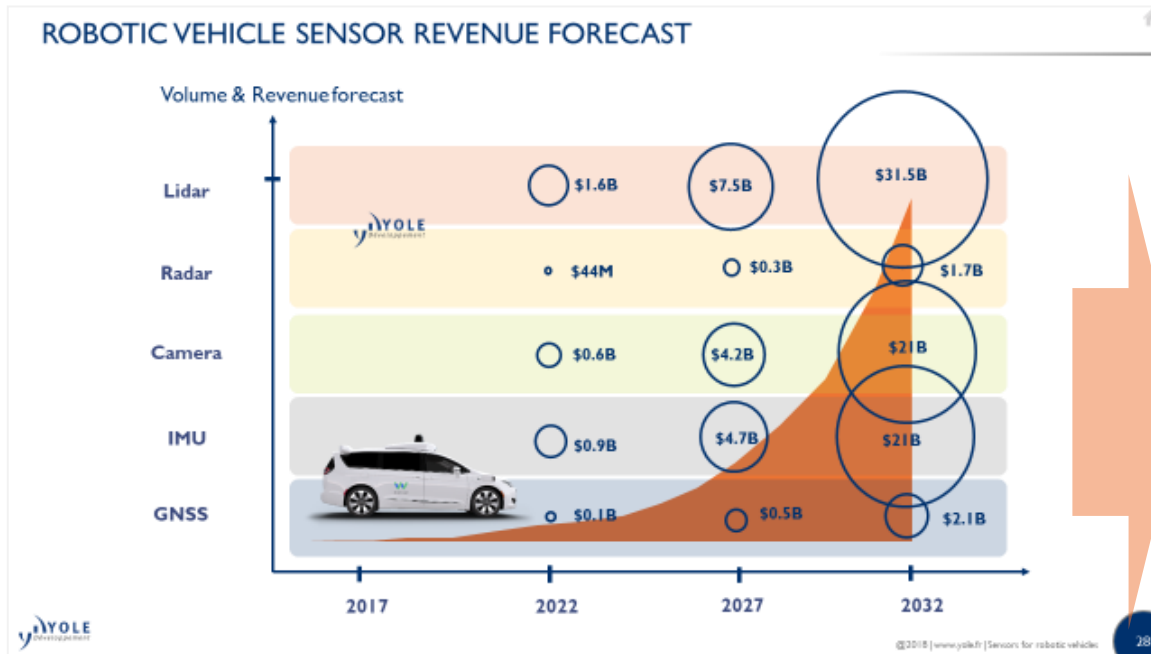
# WHAT WE GOT RIGHT, WHAT WE GOT WRONG

## Technology and market forecast - challenge

### Yole Développement is pushing its robotic vehicle forecast 5 years out

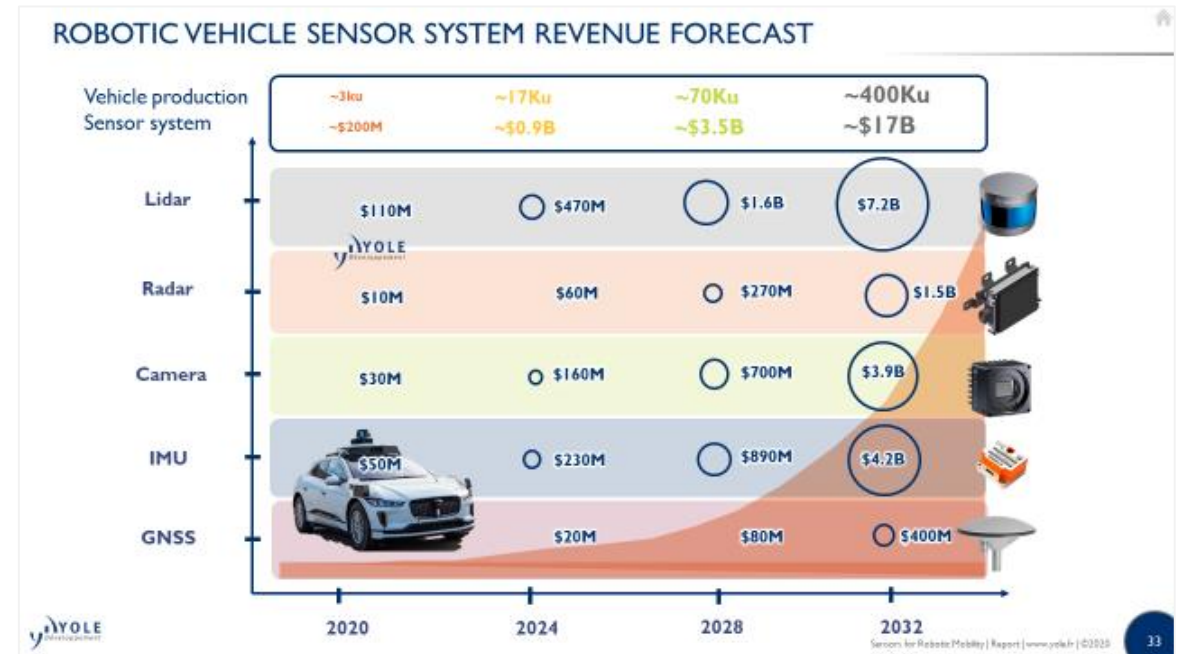
#### 2018 forecast

Sensors for robotic vehicle 2018



#### 2020 forecast

in this report

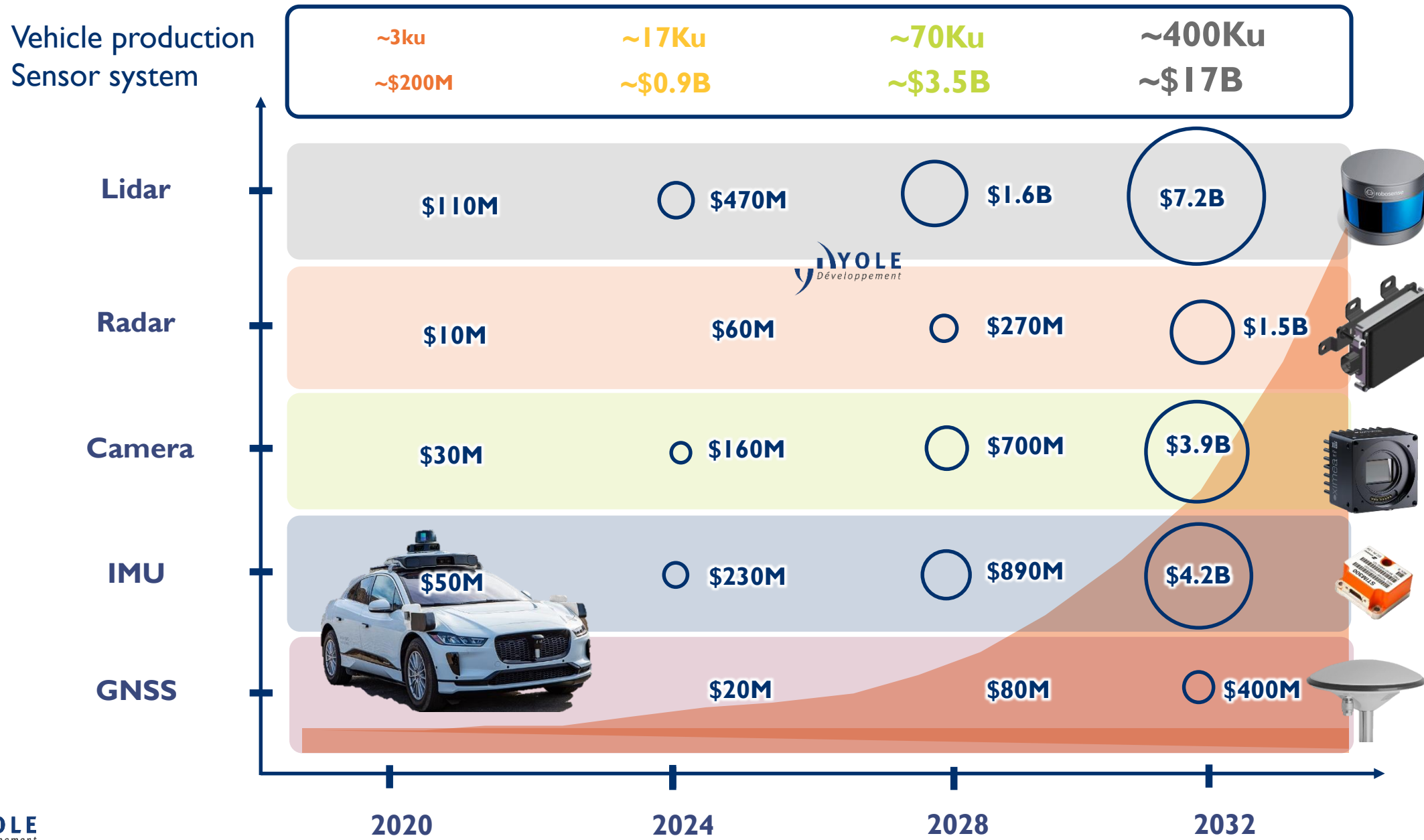


## 2020 Conclusions

- 2020 will be the year of industrialization of initial robotic vehicle fleets.
- Lidars, Radars, Cameras and IMUs will be the main components of sensing technology supporting this trend. Expected vehicle production will reach 17k by 2024, and 400k range by 2032.
- For the manufacture of the initial fleets, spending on sensing equipment will hold the highest share at 36% of total cost. By 2032 sensing equipment spend will still represent 28% of total capital spend on robotic vehicles hardware.
- The use of solid state and the benefit of technology scaling will help lower the price of sensing equipment while at the same time performance of this equipment will rise.
- In 2019 Our forecast makes the assumption of a ~\$200,000 robotic vehicle in 2019. By 2032 the total robotic vehicle cost will decrease toward \$124,000.

Robotic vehicles are a game changer for the high end sensing market

# ROBOTIC VEHICLE SENSOR SYSTEM REVENUE FORECAST



# YOLE GROUP OF COMPANIES RELATED REPORTS

## Yole Développement

### Radar and Wireless for Automotive: Market and Technology Trends 2019



### Artificial Intelligence Computing for Automotive 2019



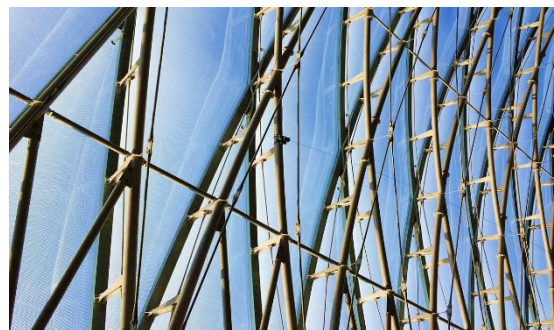
### Imaging for Automotive 2019



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### LiDAR for Automotive and Industrial Applications 2019



### Status of the Camera Module Industry 2019 – Focus on Wafer Level Optics



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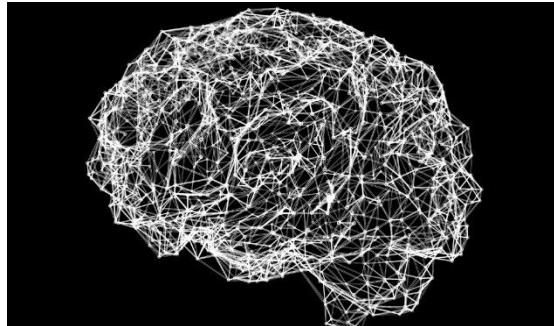
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information



### Neuromorphic Sensing and Computing 2019



### High-End Inertial Sensors for Defense, Aerospace and Industrial Applications 2020



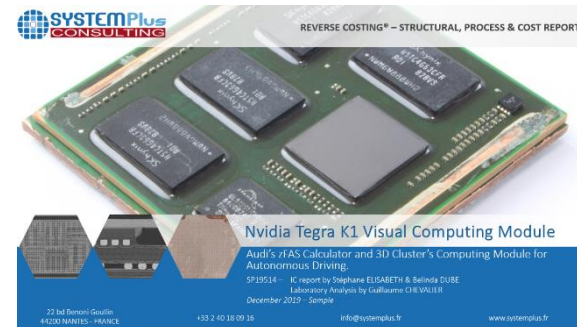
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## System Plus Consulting

### The Audi A8 zFAS ADAS Platform by Aptiv



### Nvidia Tegra K1 Visual Computing Module



### Tesla Model 3 Driver-Assist Autopilot Control Module Unit



Contact our Sales Team for more information



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