

Semiconductor  
industry: market &  
technical issues  
for the renewal of  
this sector

Jean-Christophe Eloy

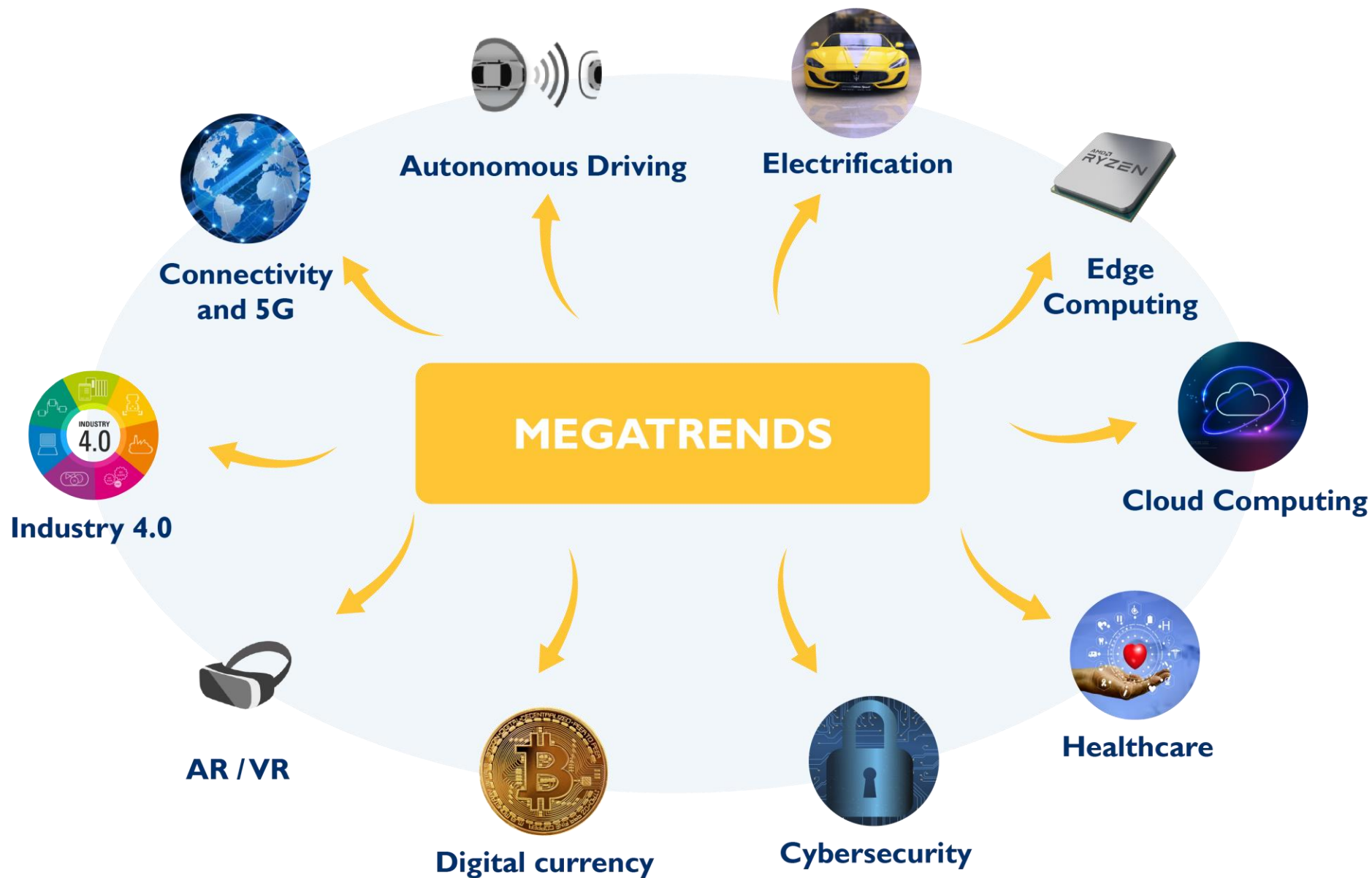
President & CEO

**YOLE DEVELOPPEMENT**

# OUTLINE

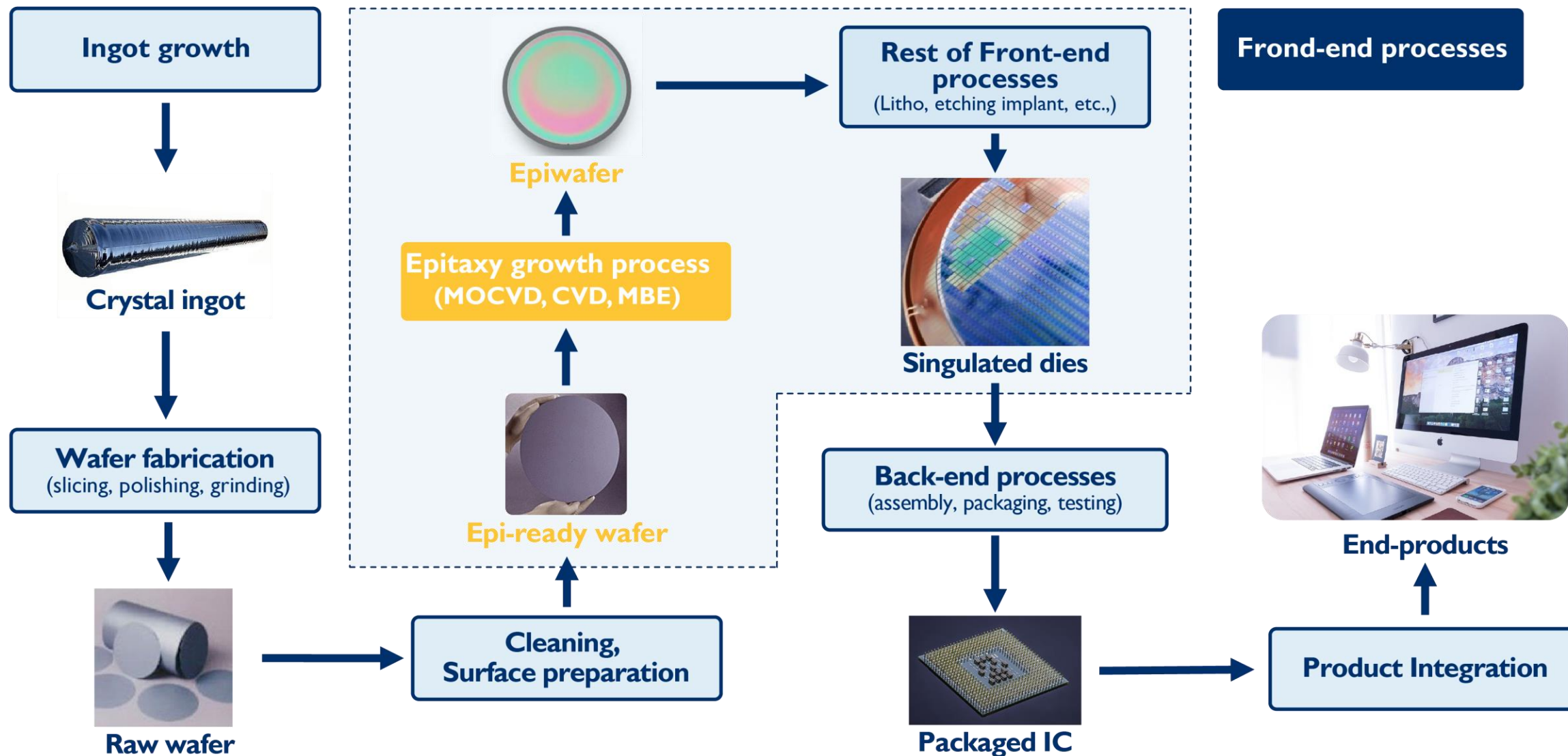
- Key megatrends of this decade
- Overview of semiconductor manufacturing process
- How complex are epitaxy layers
- How megatrends translate to equipment demand
- Competing techniques for MBE
- RIBERT equipment
- Key markets served by RIBER equipment
- MBE market forecast
- Potential game changers
- RIBER, a French leader at the world stage

# KEY MEGATRENDS OF THIS DECADE





# OVERVIEW OF SEMICONDUCTOR MANUFACTURING PROCESS



**Front-end processes**

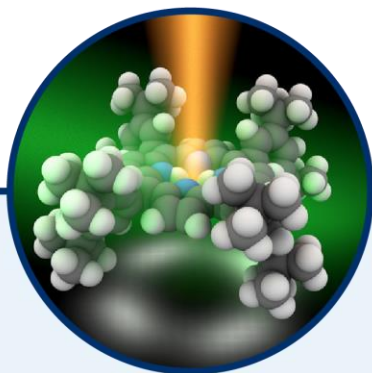


**End-products**

**Product Integration**

# HOW COMPLEX ARE EPITAXY LAYERS

Factor of 1 : 100 Million



**2 nm layers**  
can be grown on  
up to **8-inch substrate**  
(**200 mm in diameter**)



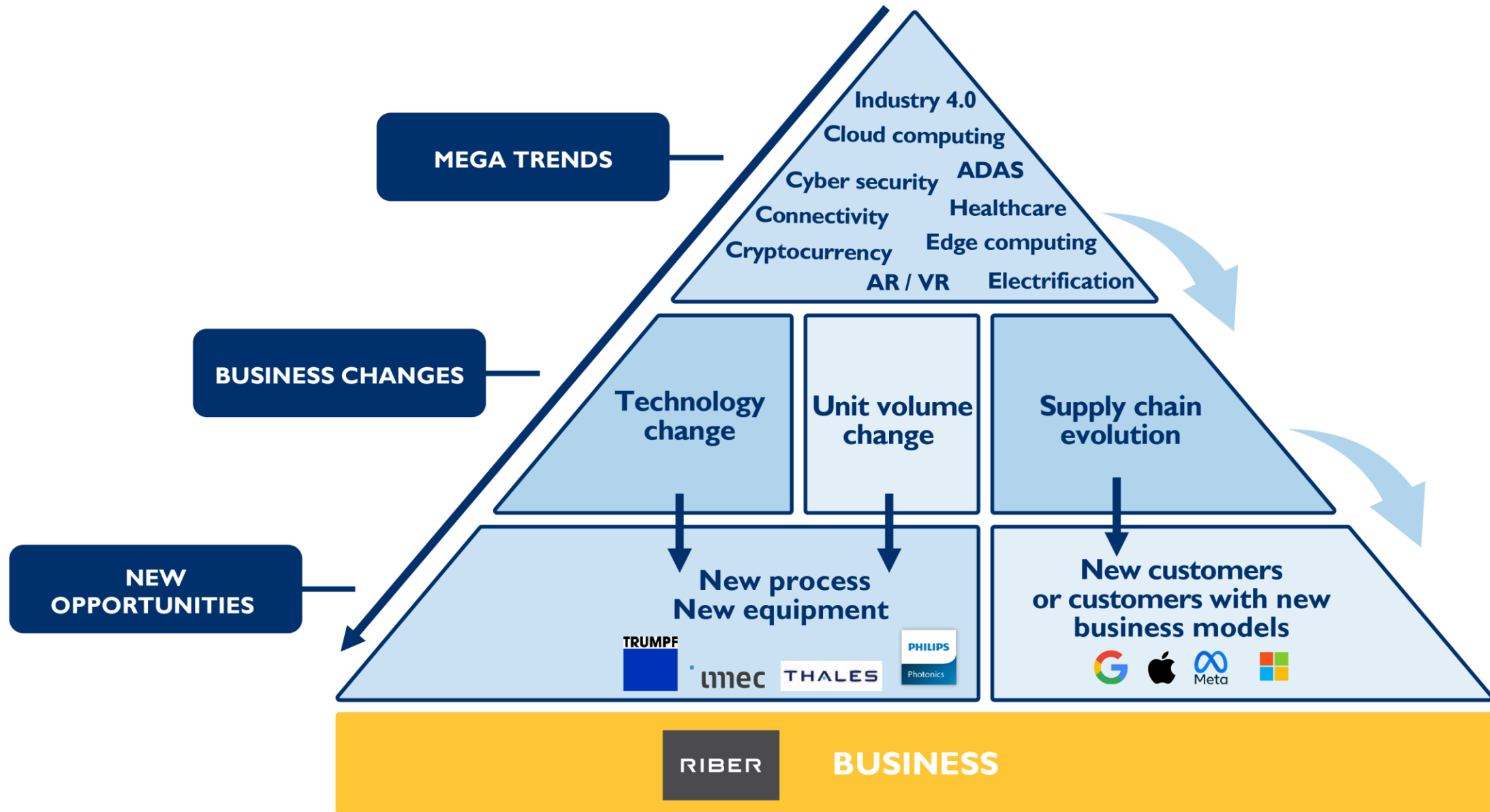
Comparable to covering  
**Football field with a layer of Bacteria**



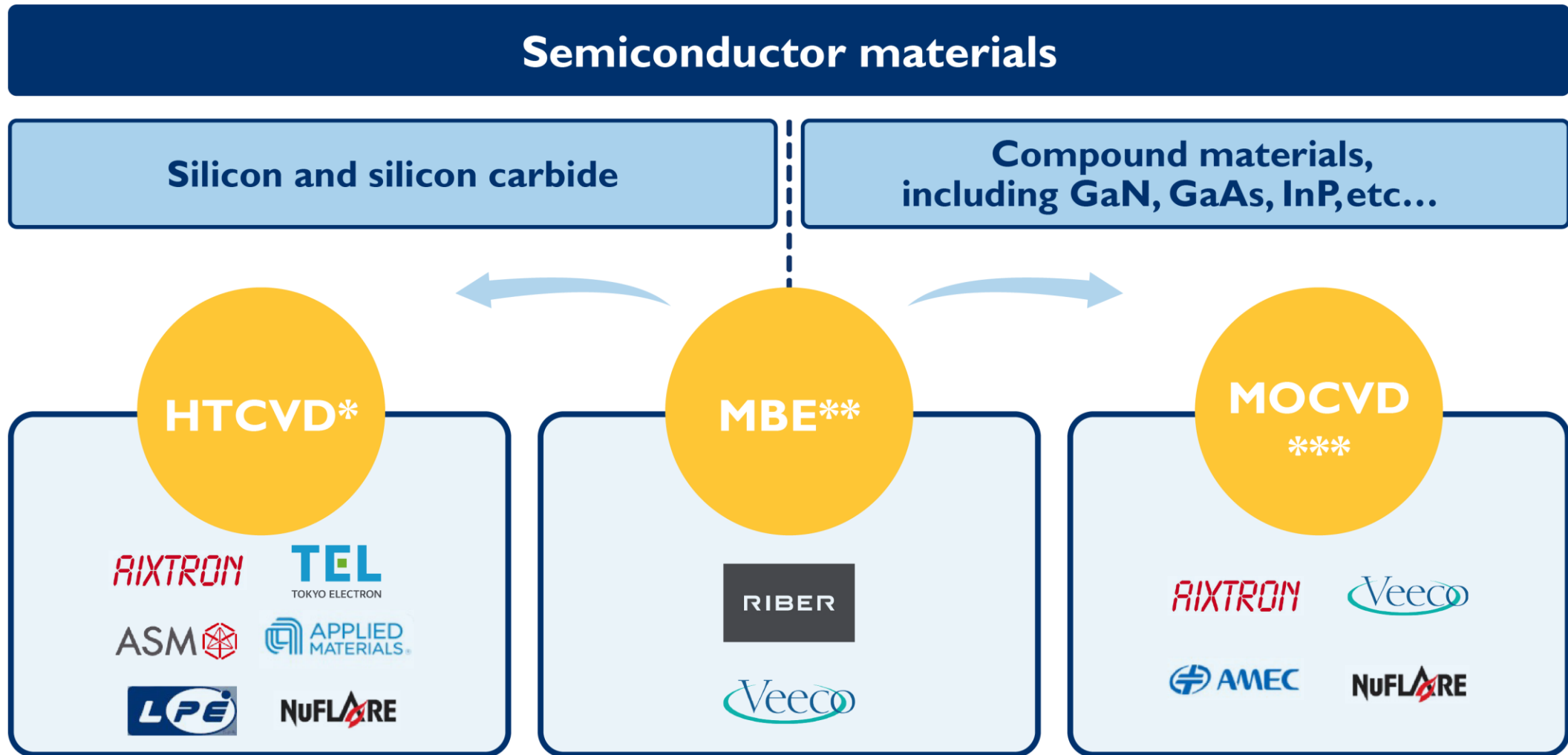
Comparable to covering  
**earth surface with 2 basketballs**



# HOW MEGATRENDS TRANSLATE TO EQUIPMENT DEMAND

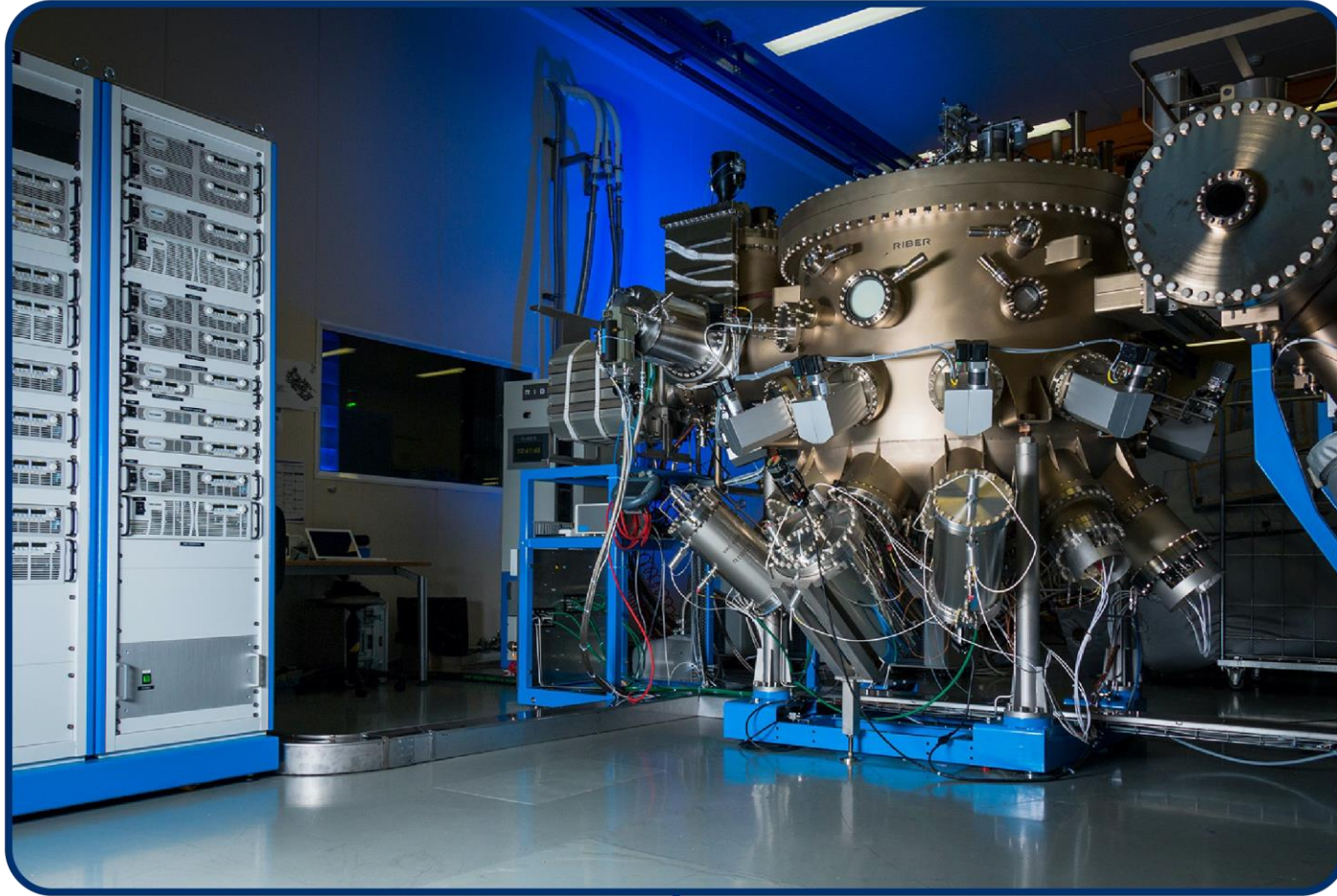


# COMPETING TECHNIQUES FOR MBE



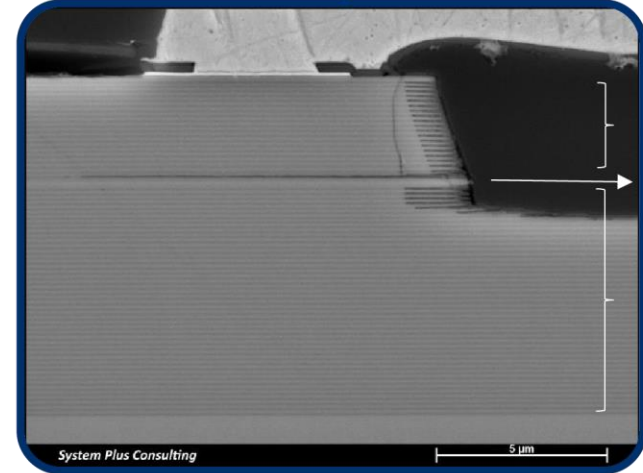
\*High Temperature Chemical Vapor Deposition - \*\* Molecular Beam Epitaxy - \*\*\* Metal Organic Chemical Vapor Deposition)





**RIBER MBE**

**GaAs VCSELs**



20 pairs of GaAs / AlAs layers  
(total thickness : 2.6  $\mu\text{m}$ )

Active layer with the QW  
(0.3  $\mu\text{m}$ )

46 pairs of GaAs / AlAs layers  
(total thickness : 6  $\mu\text{m}$ )

Die Cross Section © SYSTEMPlus  
CONSULTING

Note : 1  $\mu\text{m}$  = 1 / 1 million meters



# KEY MARKETS SERVED BY RIBER EQUIPMENT



Satellites



4G / 5G  
(Base stations)



Fiber Optics

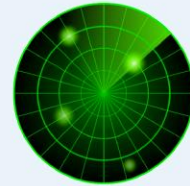


Lasers

Telecom & Infrastructure



Night vision



Radar



Infrared

Defense & Aerospace



Photovoltaic



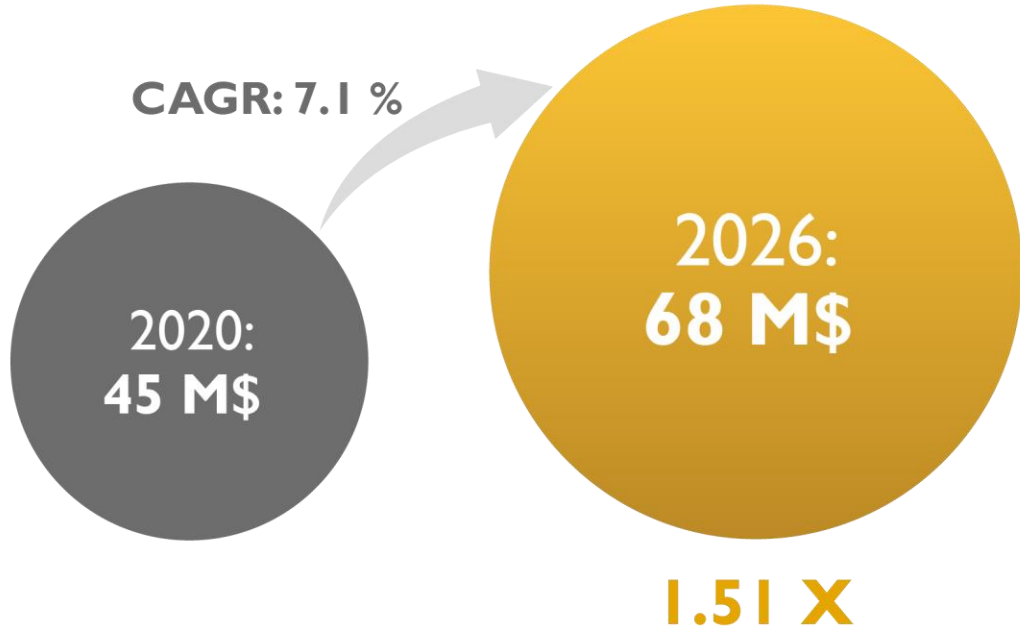
OLEDs



Ultraviolet

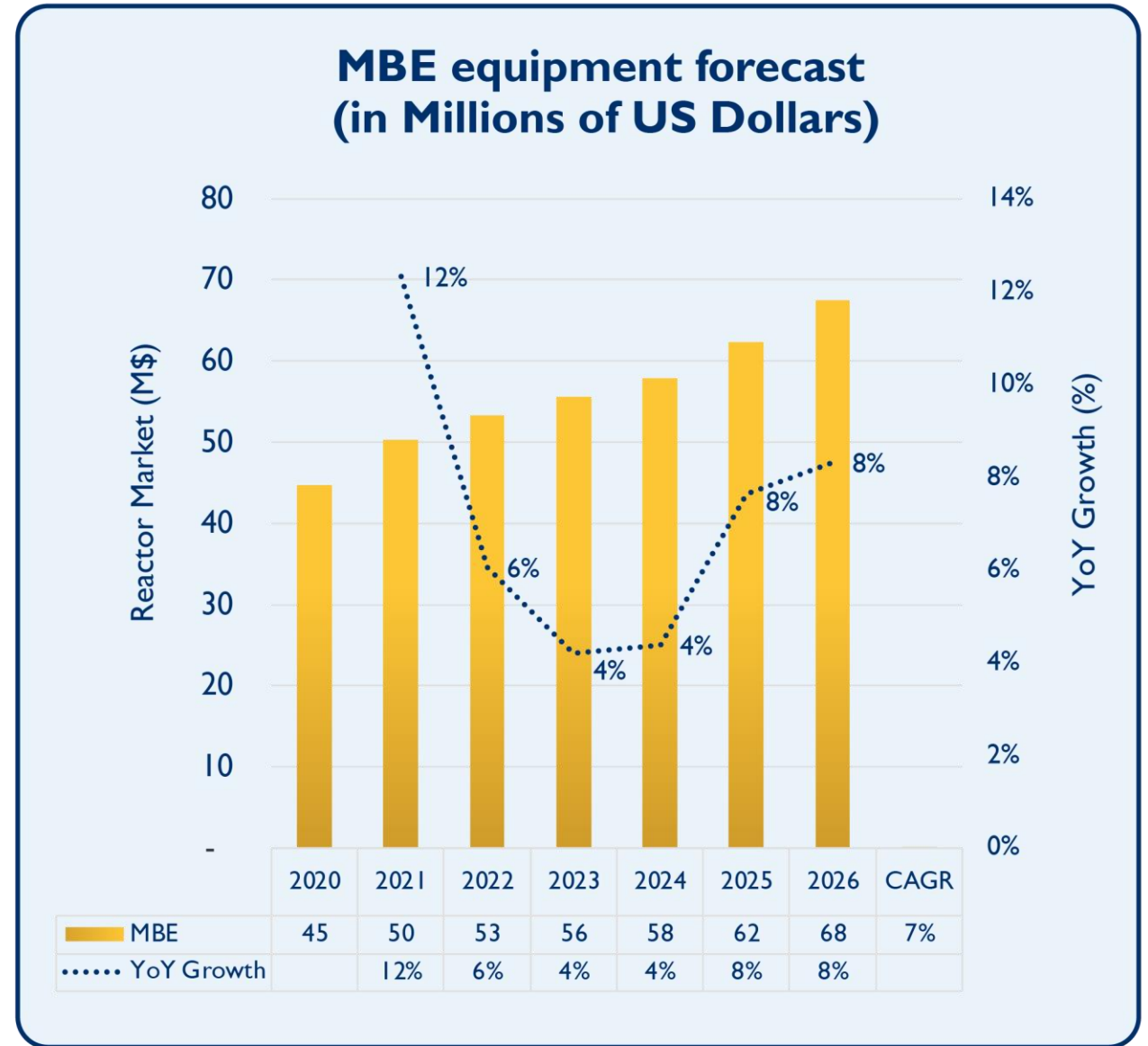
Industry

# 2020 - 2026 MBE EQUIPMENT MARKET FORECAST



2020-2026 cumulative investment: **392 M\$**

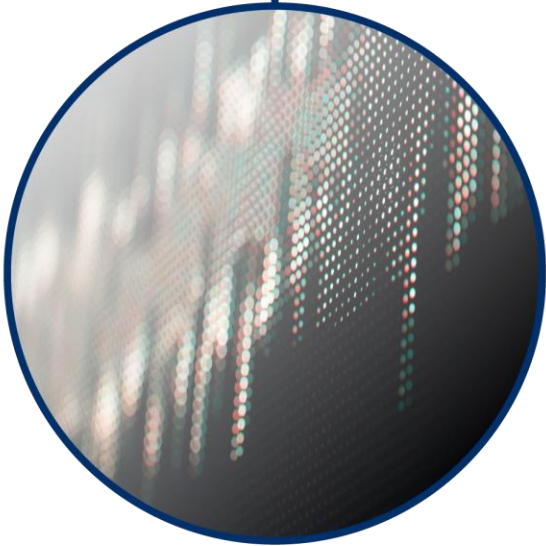
(Source: Epitaxy Equipment for More than Moore report, Yole Développement, 2021)



# POTENTIAL GAME CHANGERS



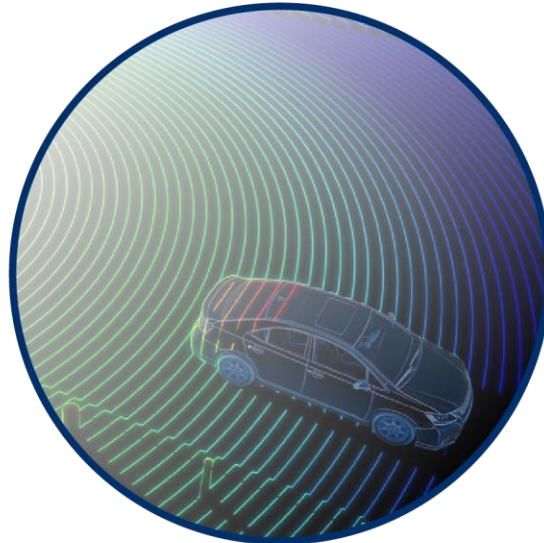
**MicroLED**



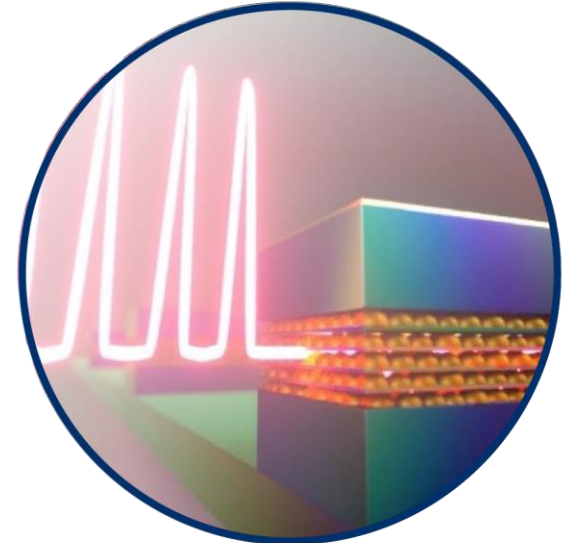
**Quantum computer**



**High-performance  
LIDAR**

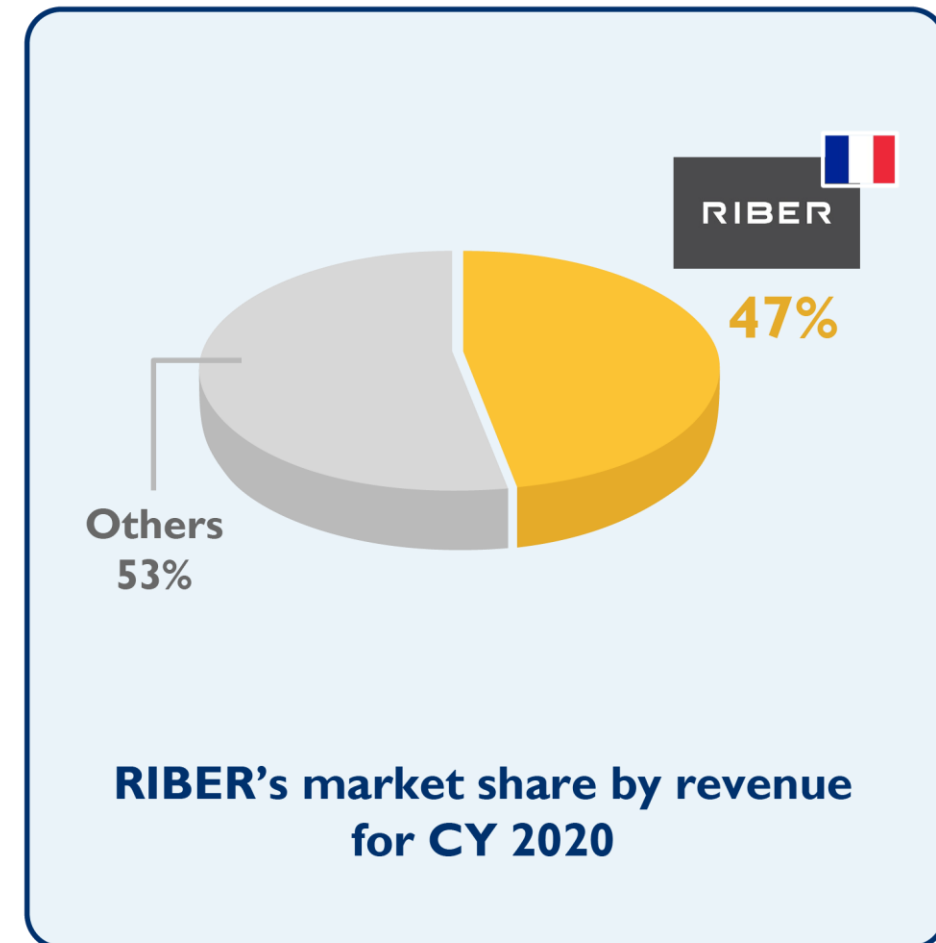
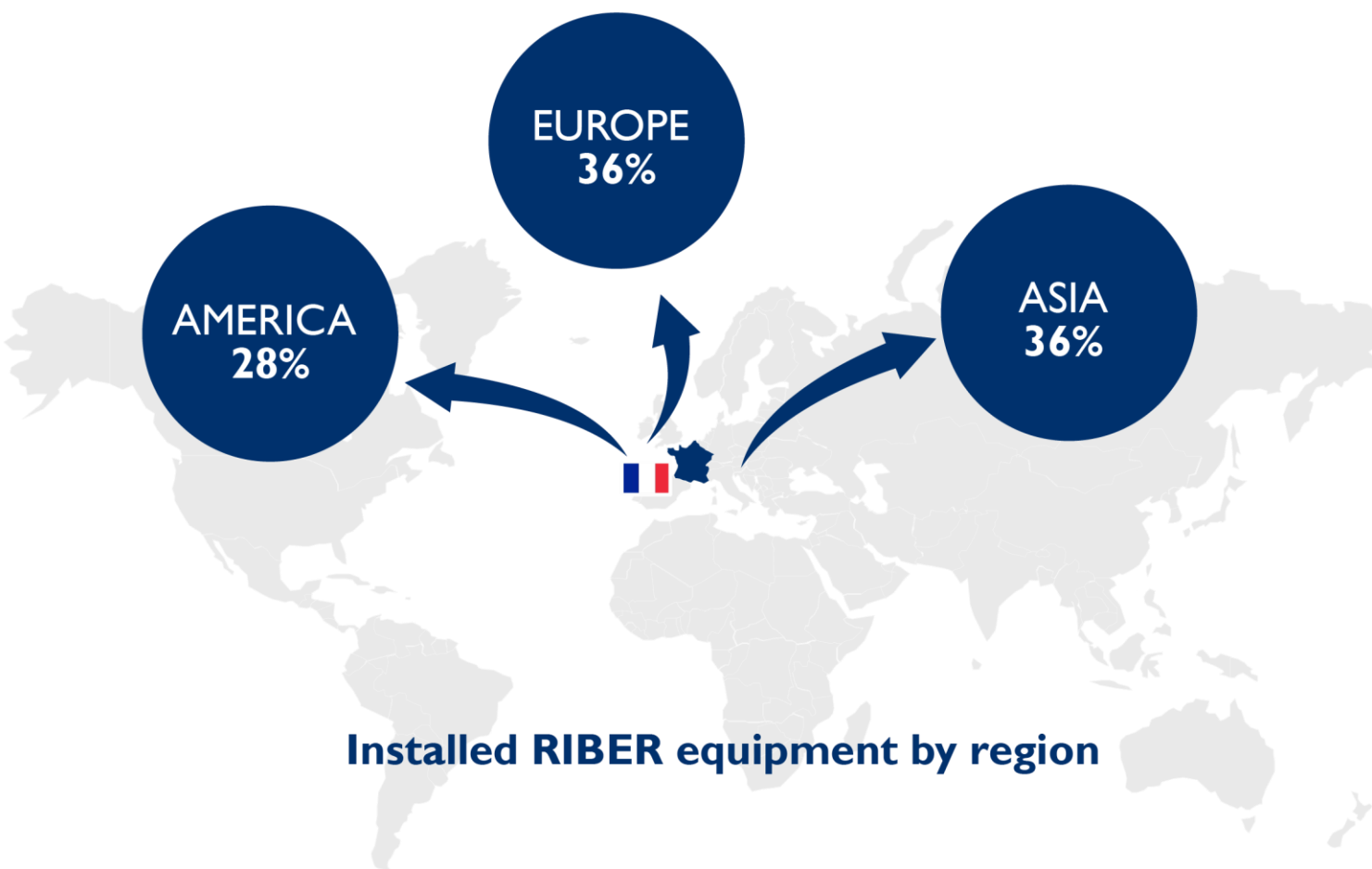


**Integrated  
Photonics**





# RIBER: A FRENCH LEADER AT THE WORLD STAGE



(Source: Epitaxy Equipment for More than Moore report, Yole Développement, 2021)

# RIBER: A FRENCH LEADER AT THE WORLD STAGE

Important players around the world are using RIBER's equipment

## AMERICA



## EMEA & ROW



## ASIA



and many more..

Annex

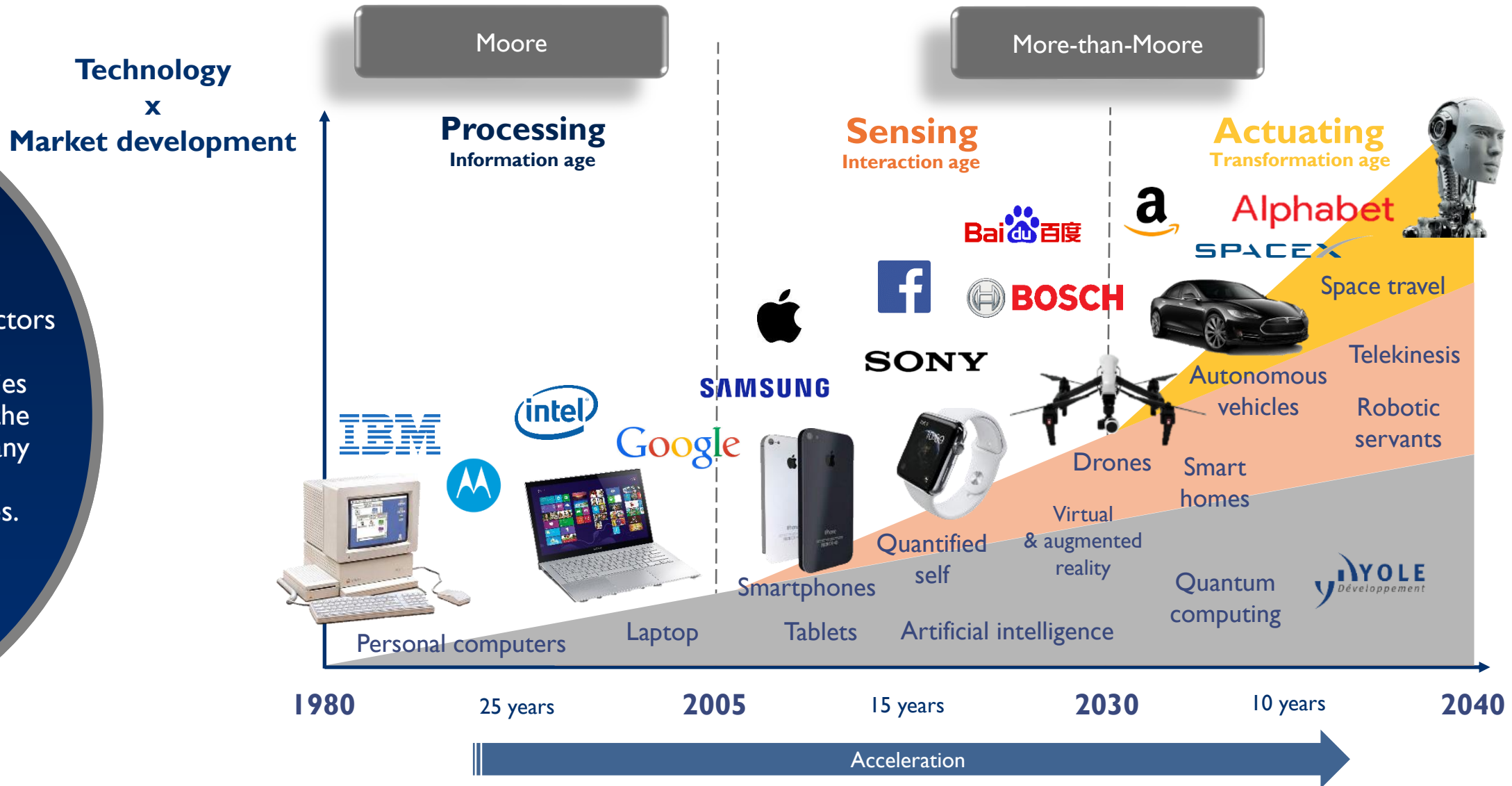
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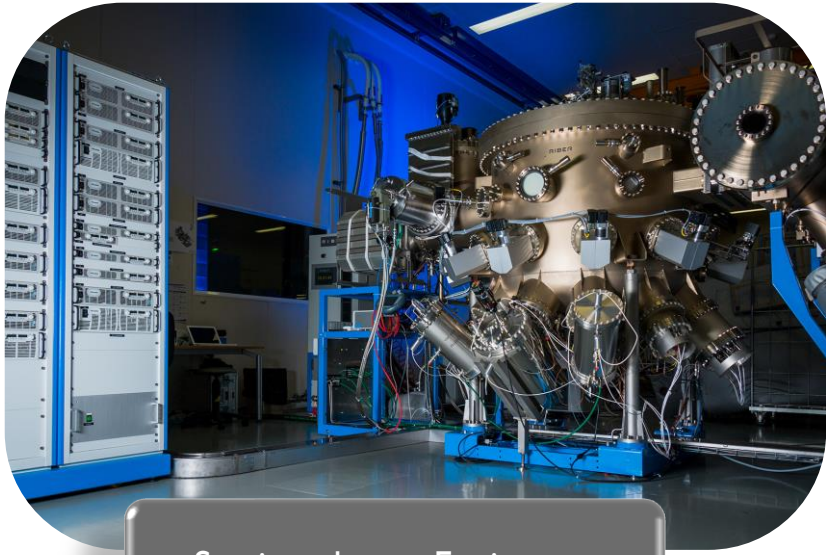
# GLOBAL TECHNOLOGY ROADMAP



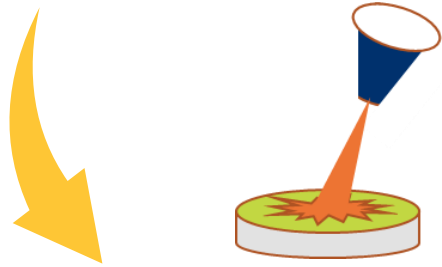
Semiconductors enable key functionalities and are at the heart of many future technologies.



# WHAT IS A SEMICONDUCTOR EQUIPMENT



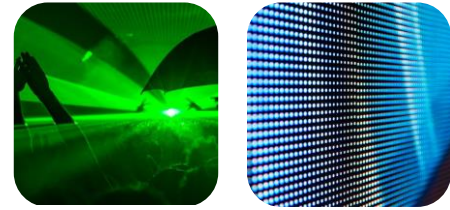
Semiconductor Equipment



Grow thin layers

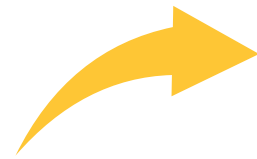


RF Sensors



Lasers Displays

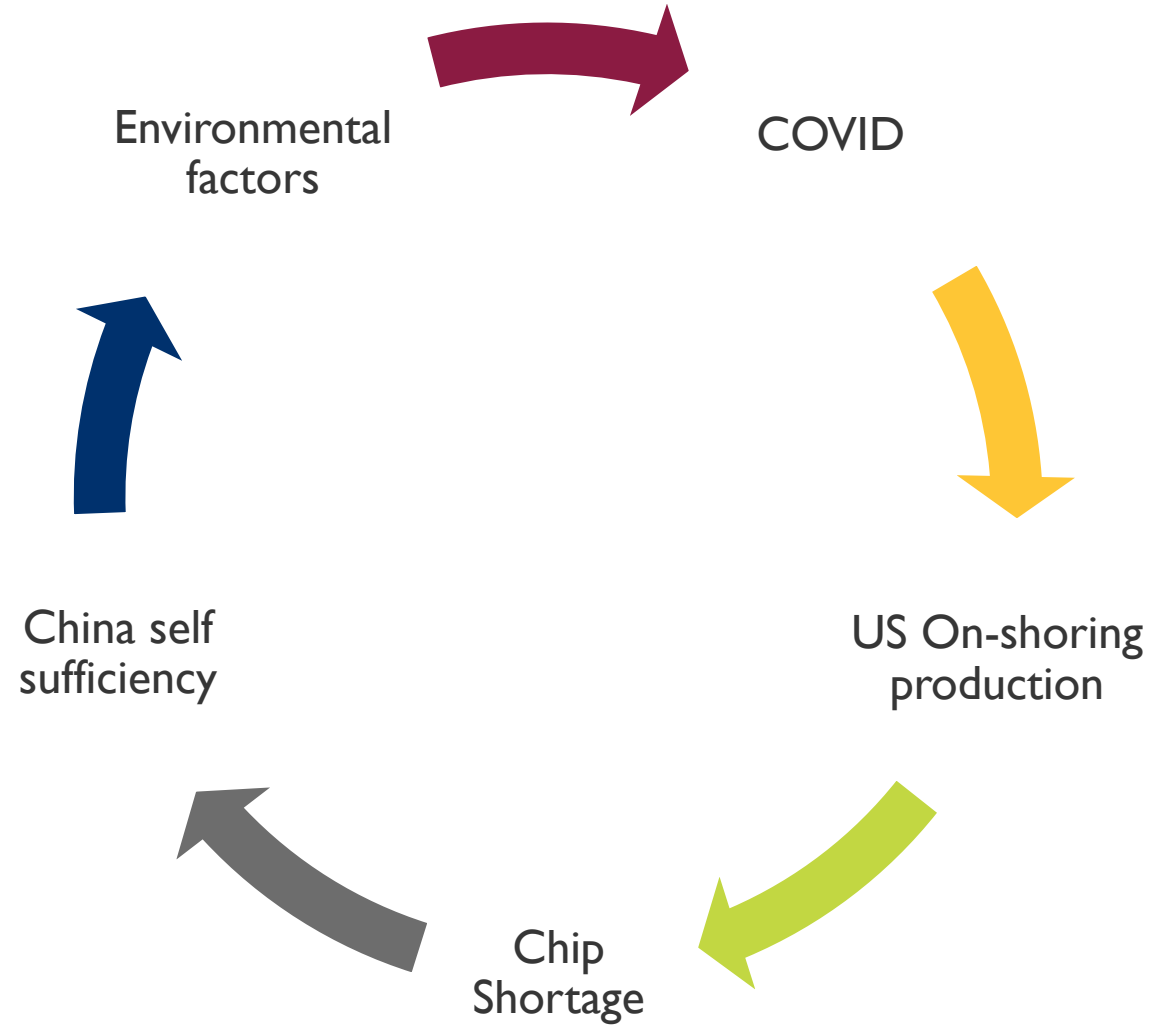
Semiconductor Devices



and many more..

End-Systems

# OTHER MACROECONOMIC FACTORS DRIVING EQUIPMENT DEMAND





# Yole Développement

*Who are we?*



## Photonics & Sensing

- Photonics
- Lighting
- Imaging
- Sensing & Actuating
- Display



## Semiconductor, Memory & Computing

- Semiconductor Packaging and Substrates
- Semiconductor Manufacturing
- Memory
- Computing and Software



## Power & Wireless

- RF Devices & Technologies
- Compound Semiconductors & Emerging Materials
- Power Electronics
- Batteries & Energy Management



# 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, Telematics

**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

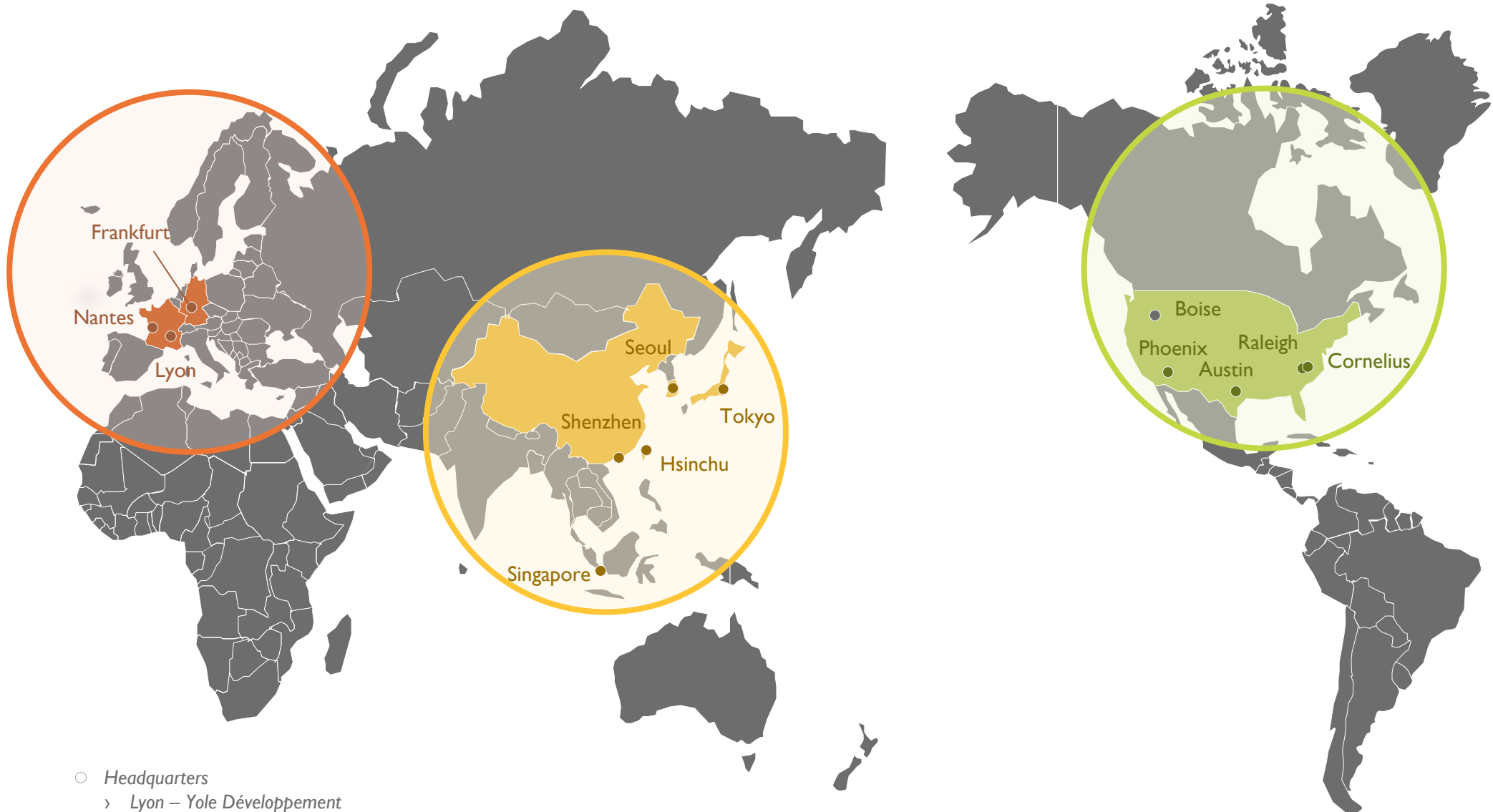
**190 custom projects per year**





# A WORLDWIDE PRESENCE

100+ collaborators in 8 different countries

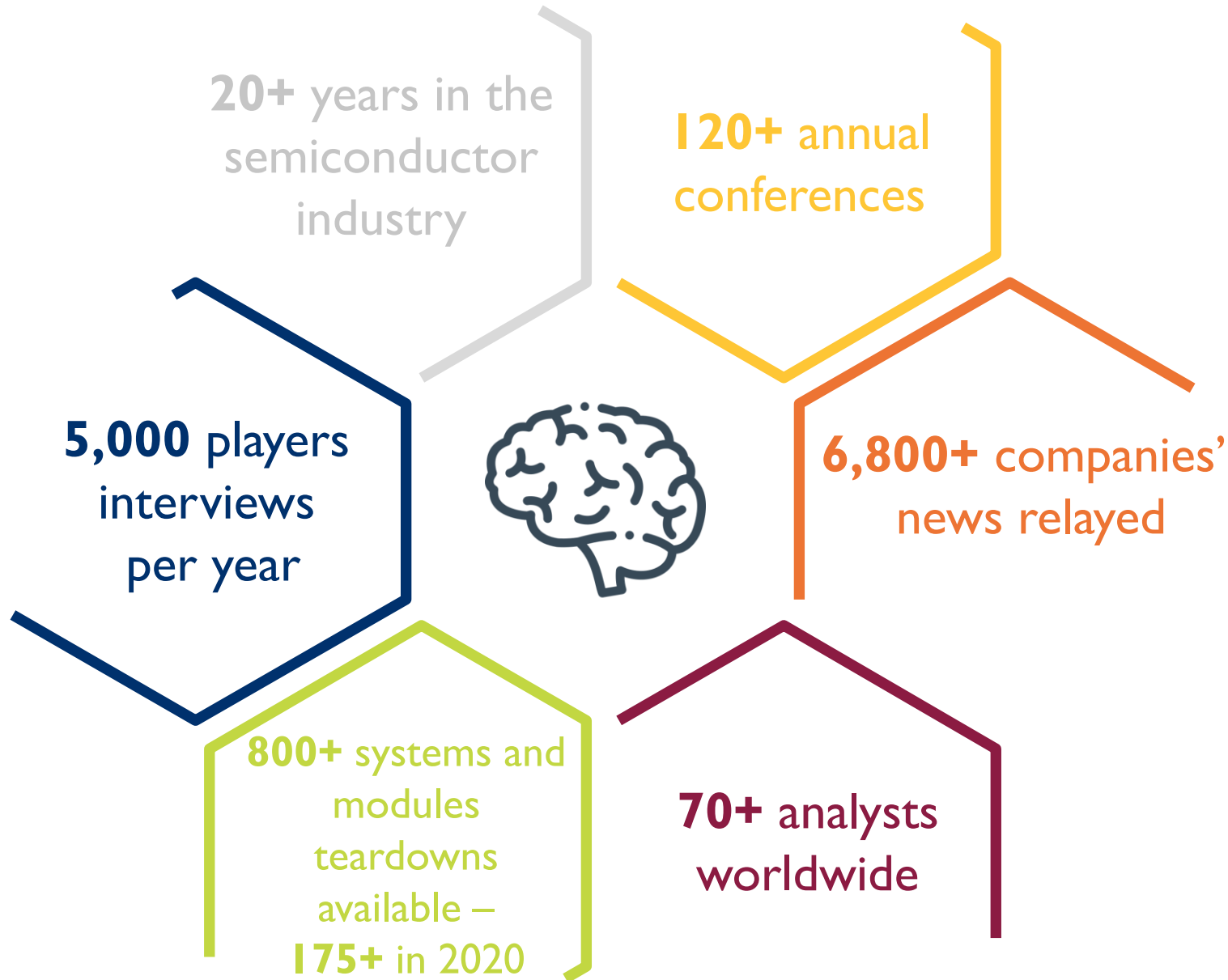


- Headquarters
  - > Lyon – Yole Développement
  - > Nantes – System Plus Consulting

# A WIDE RANGE OF INFORMATION SOURCES



Our unique position allows us to obtain detailed and accurate information to meet your needs

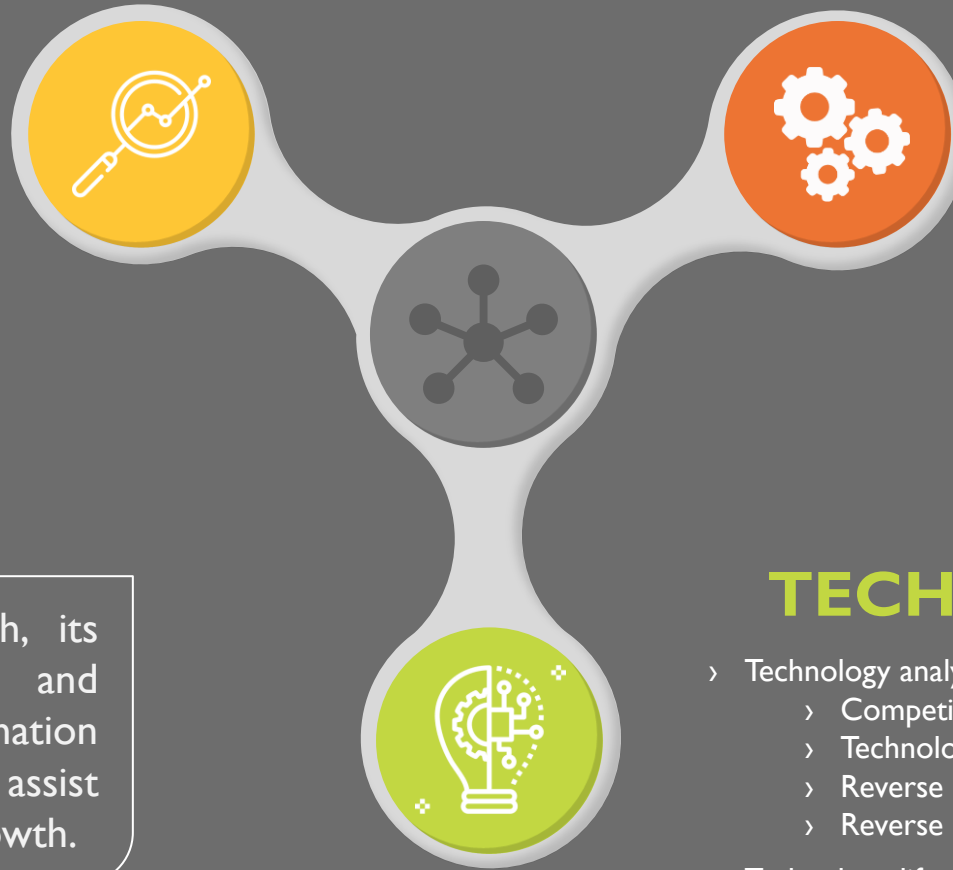




## MARKET

- › Market segmentation
  - › Per application
  - › Per technical needs
  - › Per technology adoption and behavior of the supply chain

Thanks to its marketing approach, its understanding of the industrial and technical environment and information collection, Yole Développement can assist companies at every stage of their growth.



## BOTTOM-UP & TOP-TO-BOTTOM

- › Top to bottom
  - › Industry organizations
  - › Aggregate of market forecasts at system and device levels up to the wafer and equipment
- › Bottom-up
  - › Ecosystem analysis
  - › Aggregate of all players' revenue at device, module and system levels
- › In unit, dollar and wafer

## TECHNOLOGY

- › Technology analysis
  - › Competitive landscape
  - › Technology comparison
  - › Reverse costing
  - › Reverse engineering
- › Technology life cycle
  - › Development cycles
  - › Adoption by the supply chain
  - › HV manufacturing and evolutions

# OUR NETWORK IS THE ENTIRE SUPPLY CHAIN ACROSS 6 MARKETS

6  
key markets



Mobile  
& Consumer



Automotive  
& Mobility



Telecom &  
Infrastructure



Medical



Defense  
& Aerospace



Industrial

Integrators,  
end-users and  
software developers

**DENSO**  
Crafting the Core



SONY



Panasonic



Canon



**TOSHIBA**  
Leading Innovation >>>

Device  
manufacturers



OSRAM



InvenSense



Suppliers: material,  
equipment, OSAT, foundries...



Financial investors, R&D centers







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