



ALTER

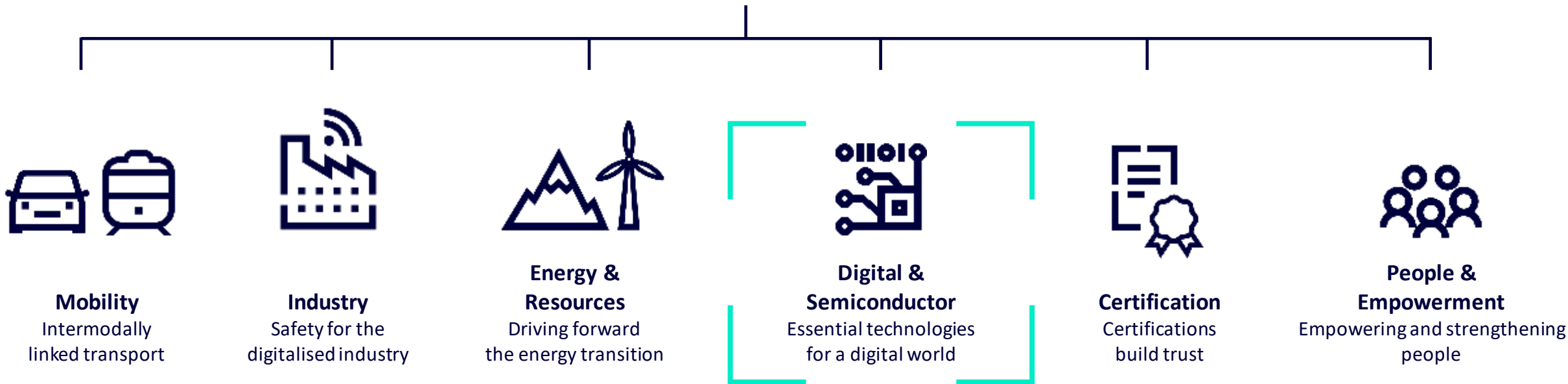
The Future of European OSAT Supply Chains

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Alter Technology

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TÜVNORDGROUP



We create trust in technology

Below ground, on ground, in space.

Alter Technology Group

ALTER at a glance (2022's figures)



82

Million Euros Revenues



470

Employees



36

Years in the market



7

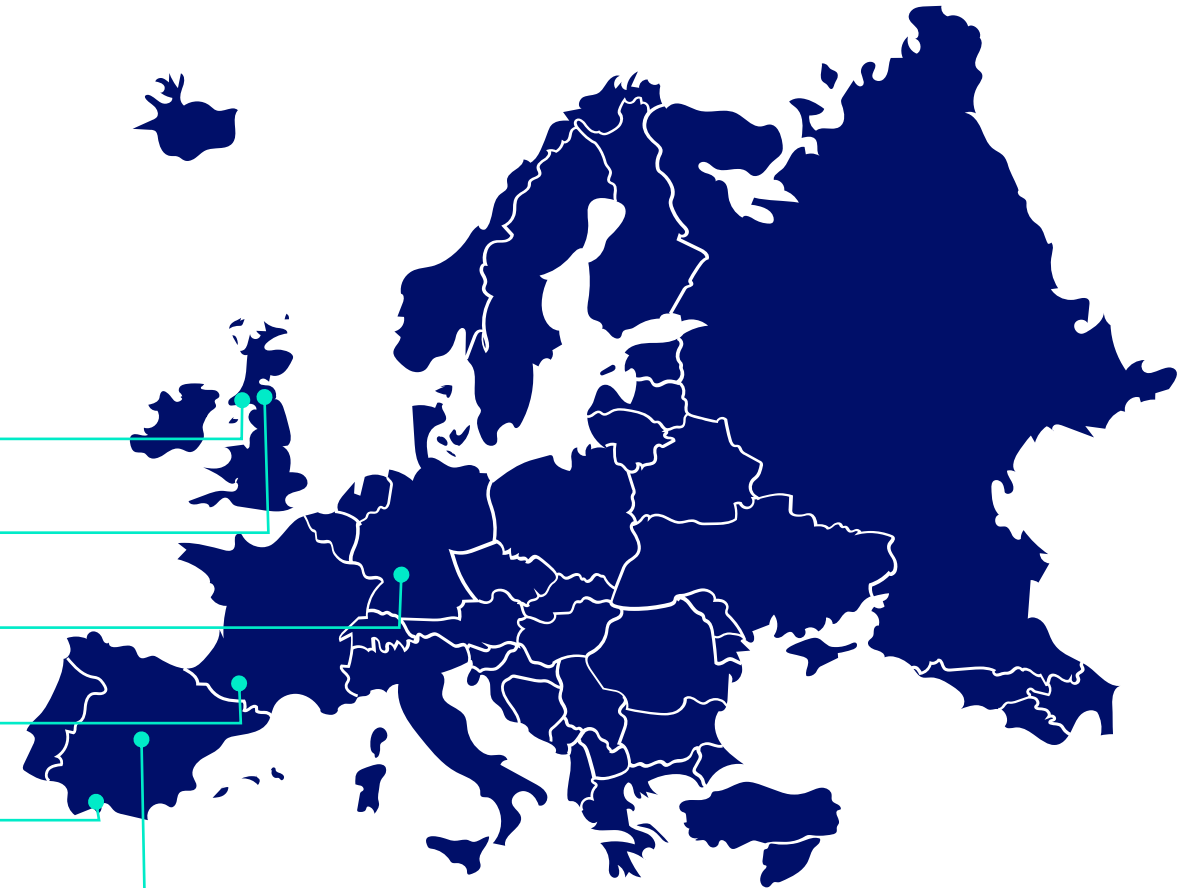
sites



>8500

M2 laboratories

- ALTER – Glasgow (Photonics Design Centre)
- ALTER – Livingston (Packaging)
- HTV – Bensheim (Test, Programming, Long Term Storage)
- ALTER – Toulouse (Test, Qualification, Procurement)
- ALTER – Seville (Test, Qualification, Procurement)
- ALTER – Madrid (Optoelectronic & Equipment Testing)



My OSAT Credentials



Megatrends, Macro-Economic and Geopolitical considerations driving huge growth of European Semiconductors leading to big opportunities.....

2021/22 Global Semiconductor Shortage

- Globally 7.7M cars could not be built in 2021 with \$210B revenue impact.²
- 85% of Medical Equipment companies reported shipment delays from 4 to 52 weeks.³
- Goldman Sachs estimates that 169 industries were impacted.

Geopolitical Tensions feeding into Sovereign Semiconductor Supply Chains

- China and Taiwan and Ukraine war expose vulnerability and dependence on Asian and other supply chains.
- Semiconductors National Security (and AI and Quantum) are at the centre of a new Cold War between US and China.

Semiconductors are enabling all key global megatrends and backbone of Digital Transformation

- Electrification
- Future mobility
- Next generation communications
- Digital transformations – Quantum and AI
- IoT
- Net Zero

Global Semiconductor market will increase from \$600B to \$1000B by 2030

- Semiconductors have added \$3T to Global GDP between 1995 and 2015.
- And \$11T through indirect impact through other industries during this time.
- *Semiconductors are the new Oil* - In 2020 China imported \$350B worth of semiconductors more than its Oil imports.⁴

1. IHS report "Moore's Law Impact", May 2015.

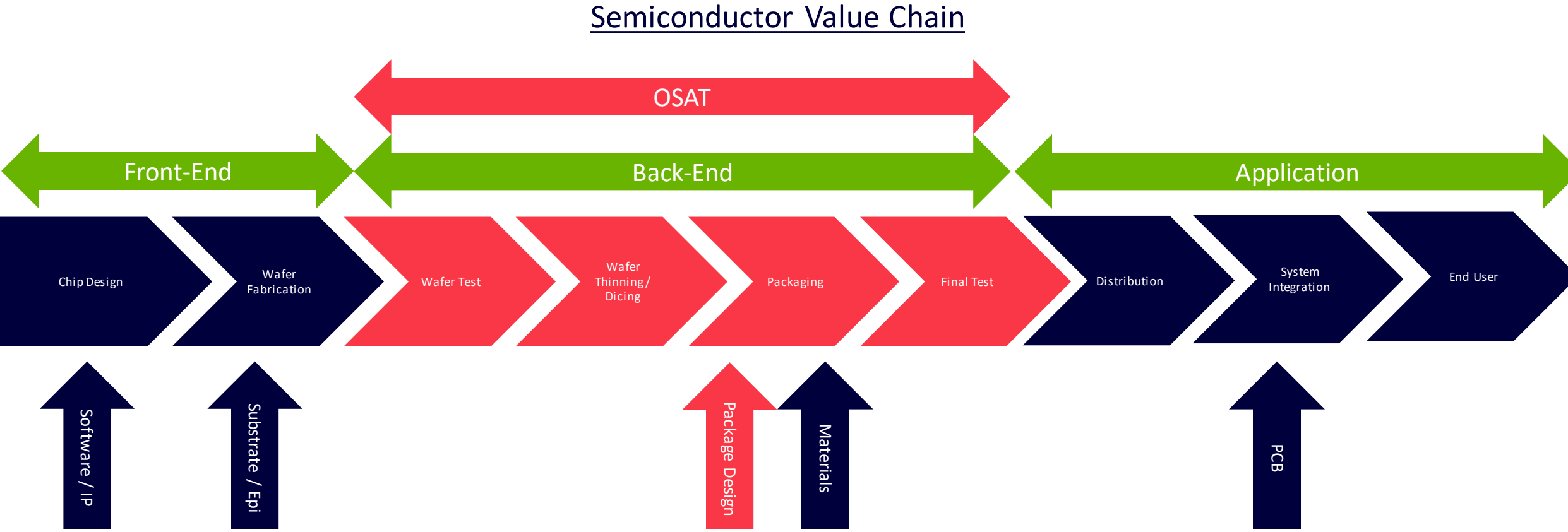
2. Goldman Sachs

3. <https://www.advamed.org/2021/09/23/the-semiconductor-chip-shortage-hits-medtech-strategies-to-build-resilient-supply-chains/>

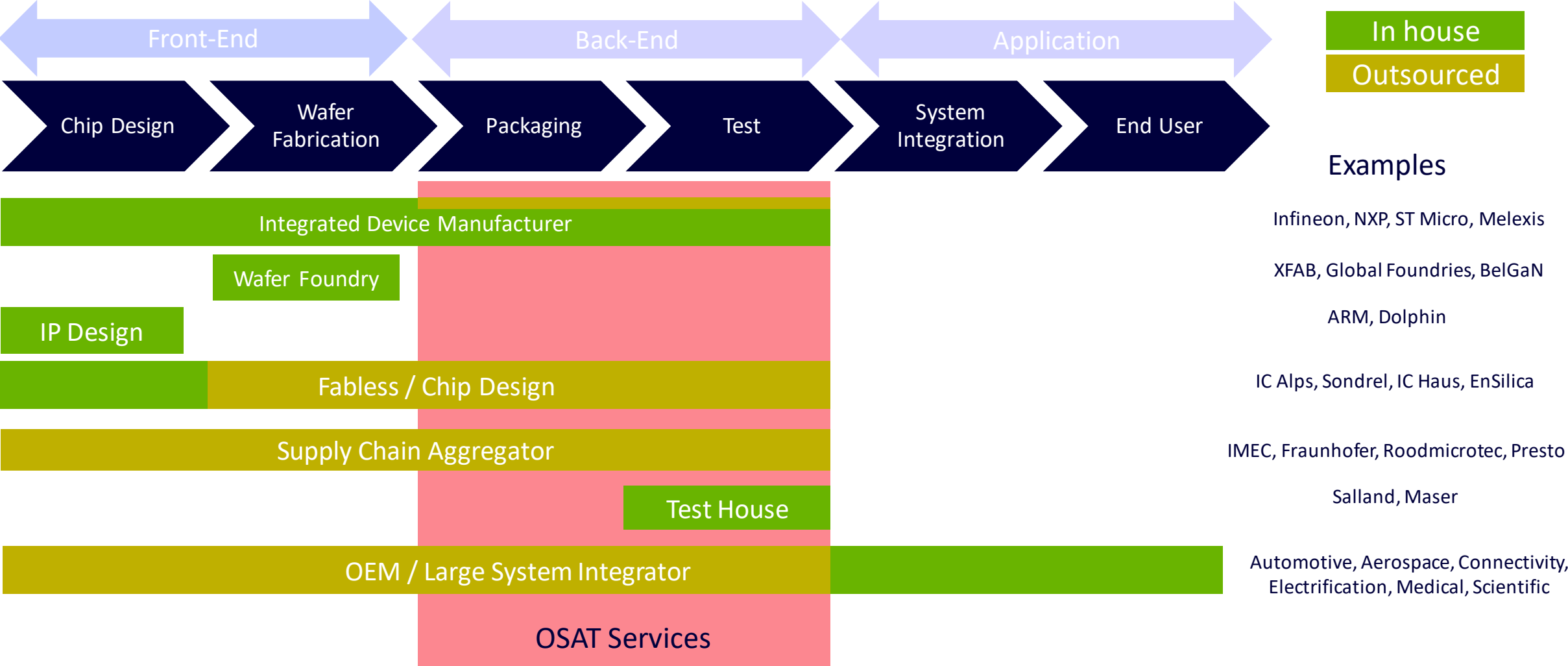
4. <https://thegeopolitics.com/the-geopolitics-of-the-new-oil-semiconductors/>

What is OSAT?

Outsourced Semiconductor Assembly & Test

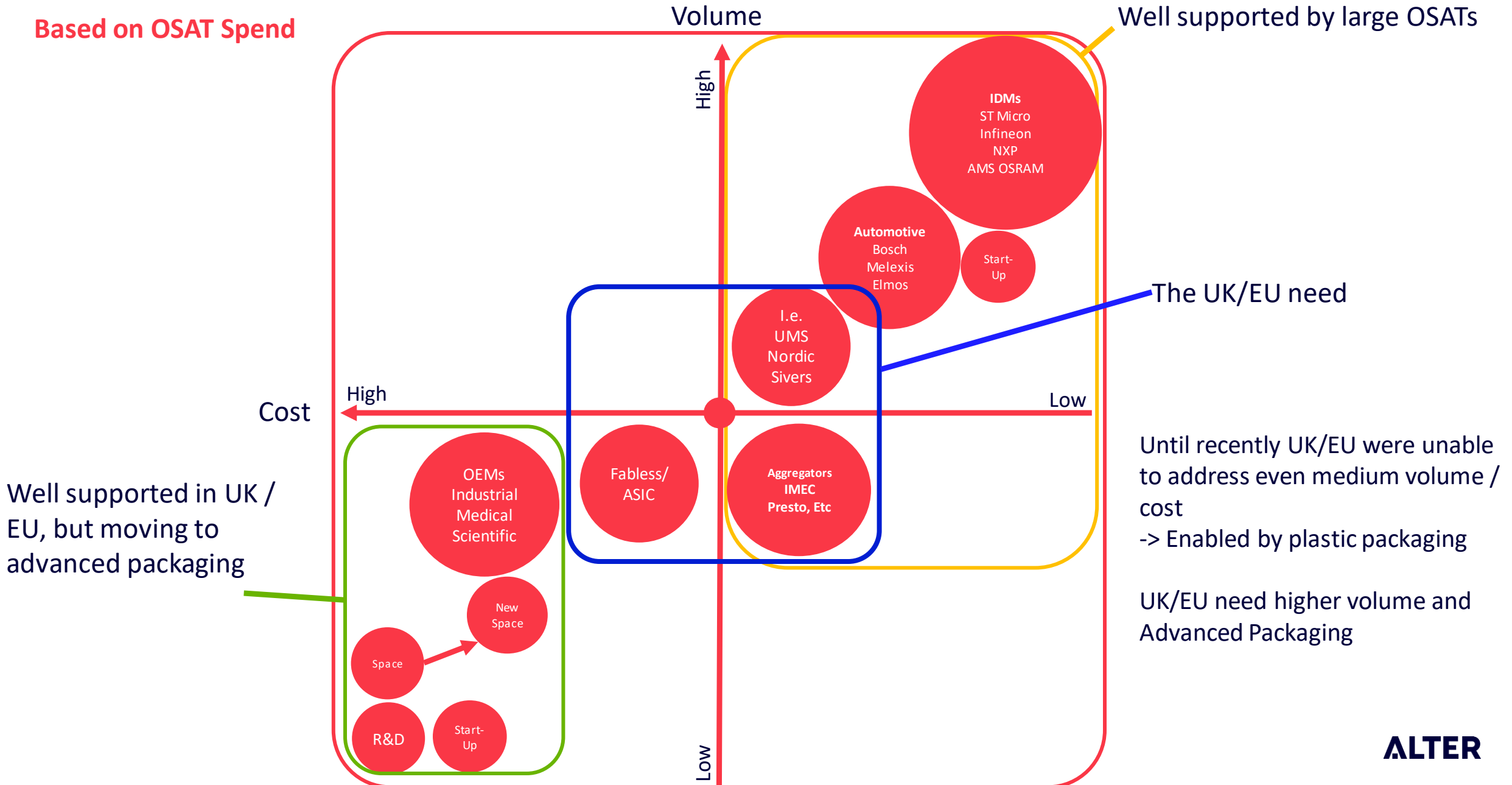


Semiconductor Value Chain

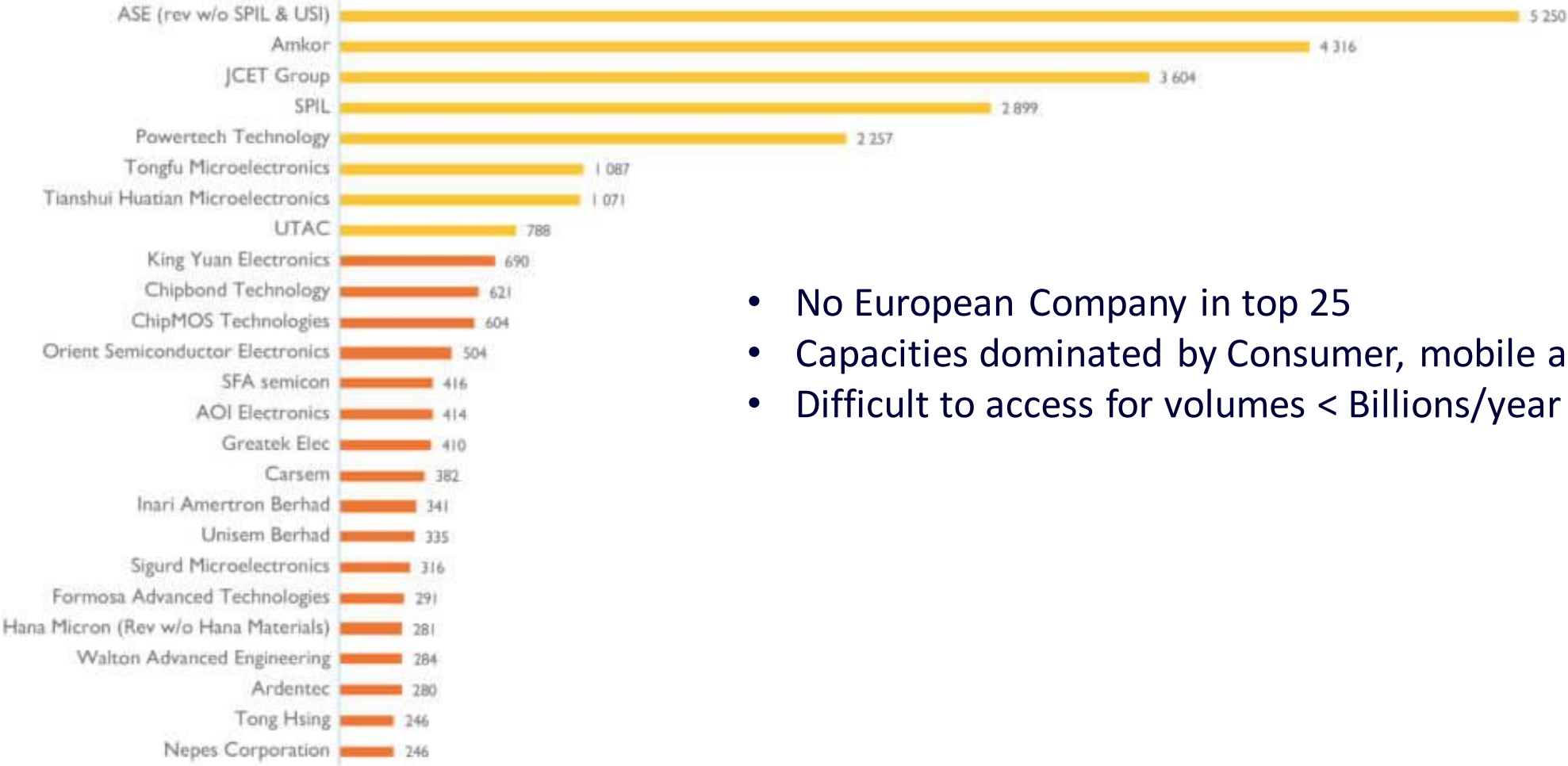


Semiconductor Market

Based on OSAT Spend



OSAT Landscape



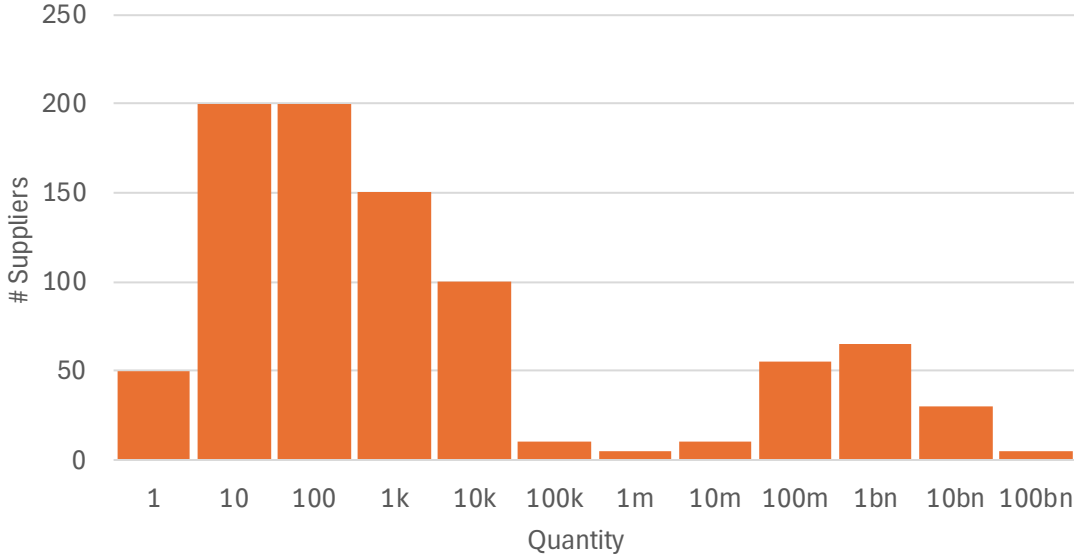
- No European Company in top 25
- Capacities dominated by Consumer, mobile and Automotive.
- Difficult to access for volumes < Billions/year

Top 25 OSAT Ranking by 2021 Revenue
Source: Yole

OSAT Landscape

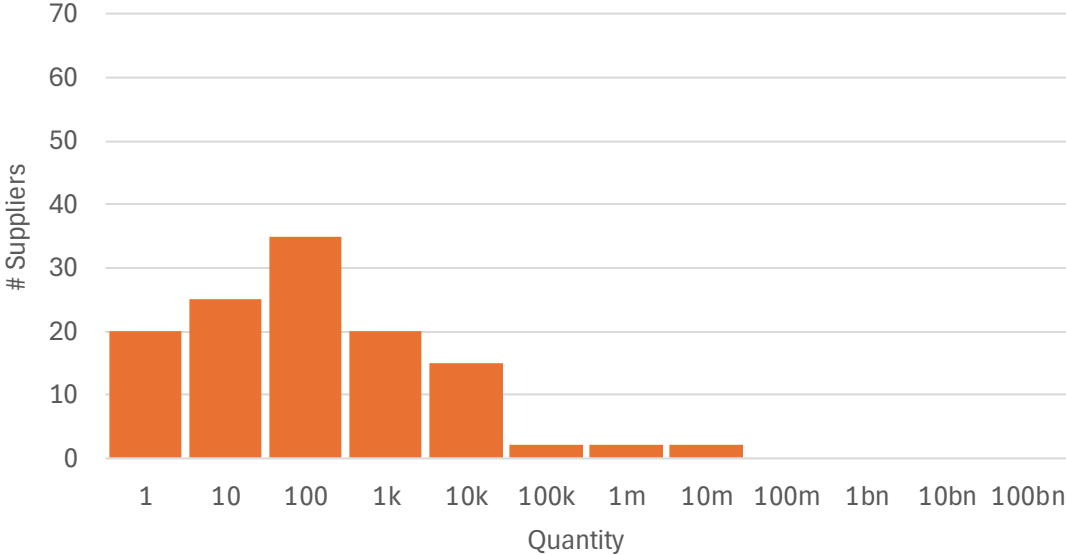
Qty demand vs. number of suppliers

Worldwide



Valley of death = medium volume

European



In Europe the valley becomes a cliff!

The European OSAT Market

OSAT MARKET DYNAMICS

Europe has around 20 "OSAT type" companies	Many of these "OSAT" companies' offshore assembly to Asia and don't have a "real" EU sovereign supply
Current EU OSAT market size is around €300M with potential for few B TAM in 2030	Many EU OSAT's are focussed on low volume with limited automation and unable to address critical volume European market
Medium volume, medium cost packaging is becoming available, such as QFN	Advanced Packaging unavailable outside of Pilot lines

OSAT Turnover (Europe)	Enterprise
EUR ~58 Mio. (18%)	ALTER
EUR ~39 Mio. (12%)	SERMA GROUP
EUR ~25 Mio. (8%)	RGM
EUR ~24 Mio. (7%)	microcross <small>one source. one solution.</small>
EUR ~ 13Mio (4%)	aptasic
EUR ~10 Mio. (3%)	RoodMicrotec
EUR ~8 Mio. (2%)	IMMS
EUR ~7 Mio. (2%)	sencio <small>functional packaging center</small>
EUR ~5 Mio. (2%)	MASER ENGINEERING
EUR ~133 Mio. (41%)	Others

Attributes of European OSAT

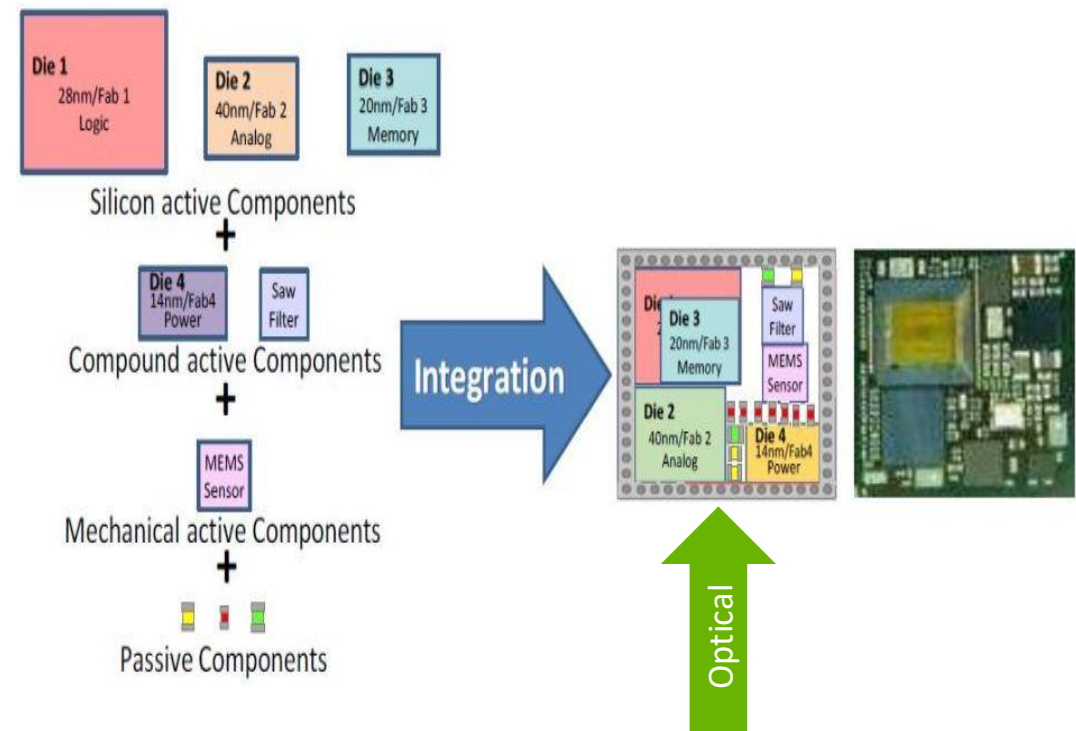


The BACKEND is the FUTURE.....More than Moore

Monolithic SoC for Advanced is becoming too expensive for many low/mid volume non-consumer applications
Heterogenous Integration and Chiplets allow for advances in performance and integration

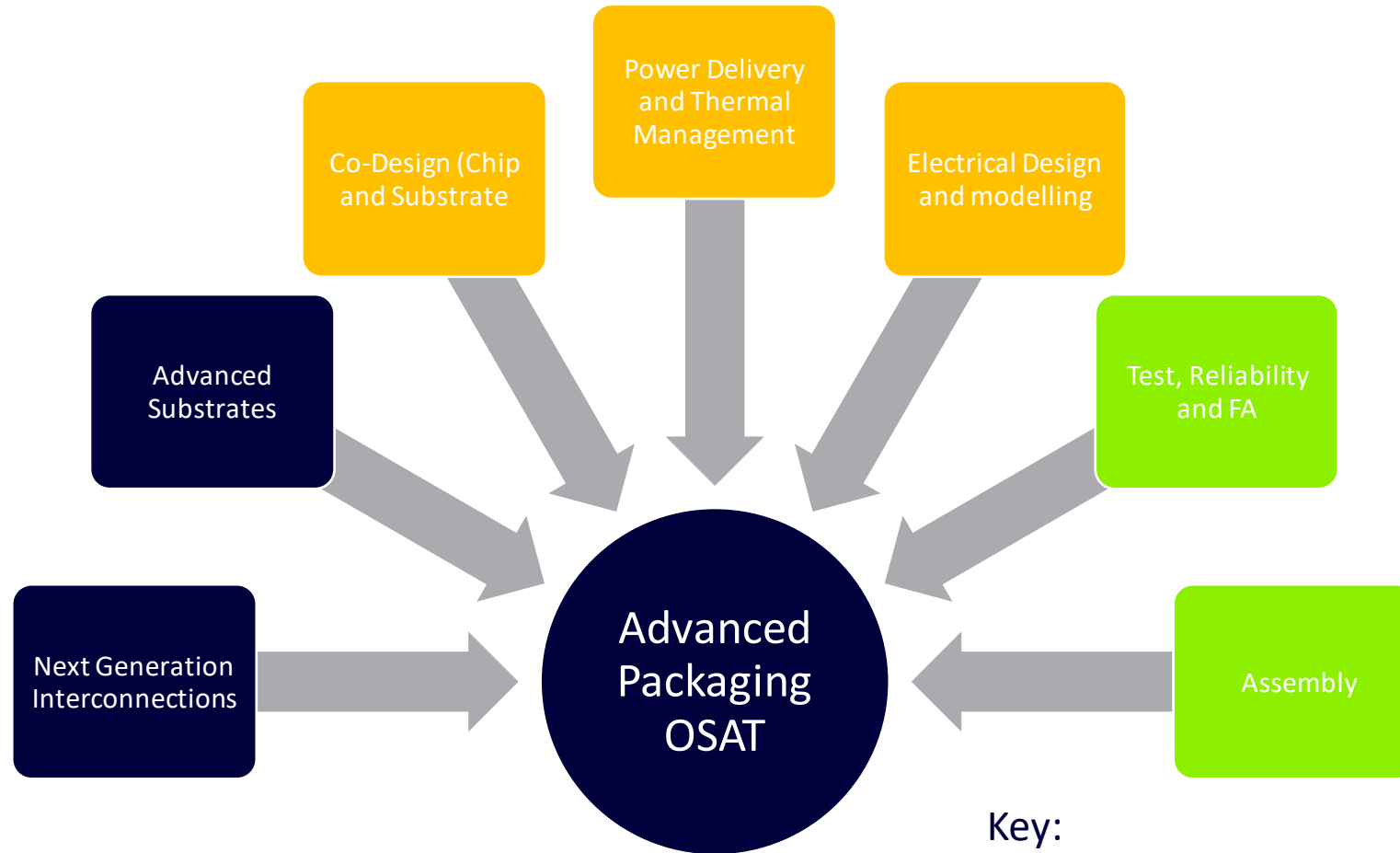
- Since the beginning of Semiconductors the industry has more or less be able to keep pace with Moore's Law which status computing power/functionality will double ever 2 years.
- Due to limitation in fundamental physics and chemistry Moore's Law is running out of steam.
- Heterogenous – compiling different semiconductor materials and technologies one platform

Compound Semiconductors play a key role – but they aren't the complete solution



Advanced OSAT – The Ecosystem Needed

No European OSAT has the full capability.



Key:

Inhouse capabilities

Capabilities to be developed

External supply chain

What's needed

Develop the Ecosystem

Volume means industrial packaging lines needed

Innovation

Automation

But we need support & investment

We've already started

Increasing Functionality and Performance and Reduced Size, Weight and Power

Device Technology

IC, ASIC, MMIC, MEMS, Sensor

Heterogeneous Integration / System-in-package. Logic/Processor, Memory, PMIC, Interface/Connectivity, Sensing.

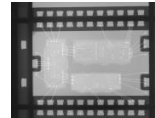
PIC, SiPhotonics, Optical Transceiver, High-speed serial

Power GaN, GaN RF, PMIC

Low Pin-count



QFN Single Die



QFN Multi-Chip Module



Optical QFN



Flip-Chip QFN

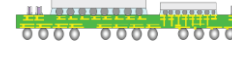
Integration



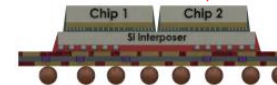
Wire bonded BGA



Flip-Chip BGA



2D System-in-Package

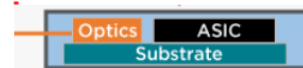


2.5D System-in-Package

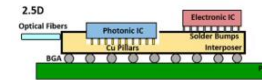
Photonics



Optical Sub-Assembly (VCSEL to Optical Interposer)



2D Co-Packaged Optics

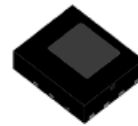


2.5D Co-Packaged Optics

Power



Power QFN



Thermal QFN



Thermally Enhanced BGA

2022

2023

2024

2025

2026

2027

2028

End-markets – Space, Aerospace, Quantum, Energy, Transport, Electrification, Communications, Industrial, Medical

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Thank you

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