3rd Chip design event

15th June 2023

sencio

functional packaging center

Important Milestones

1987 Foundation of eurasem as an OSAT

1997 Development of first plastic package for MEMS sensors

2001 Acquisition by Elmos Semiconductor AG

2011 Advanced packaging activities Elmos Semiconductor → **Sencio**

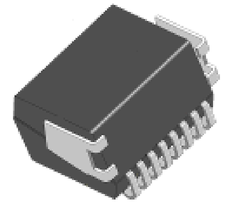
2013 Release of Assembly location in Cabuyao (Philippines)

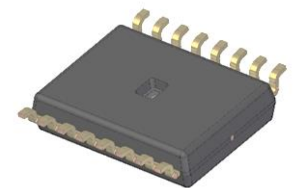
2014 Introduction of *n*Capsulate -technology

2015 Move to new location in Nijmegen

2018 60 Mio PULS since 2008

2021 High pressure sensor package for harsh environment





Facts & Figures

- Unique OSAT in Europe
- Number of employees 50
- The IATF16949 & ISO 14001 certified
- Over 600 million assemblies supplied to the Automotive Industry
- Development and manufacturing in Nijmegen (NL)
- 600 sqm clean room (class 10.000)
- Far East assembly location Cabuyao (Philippines)

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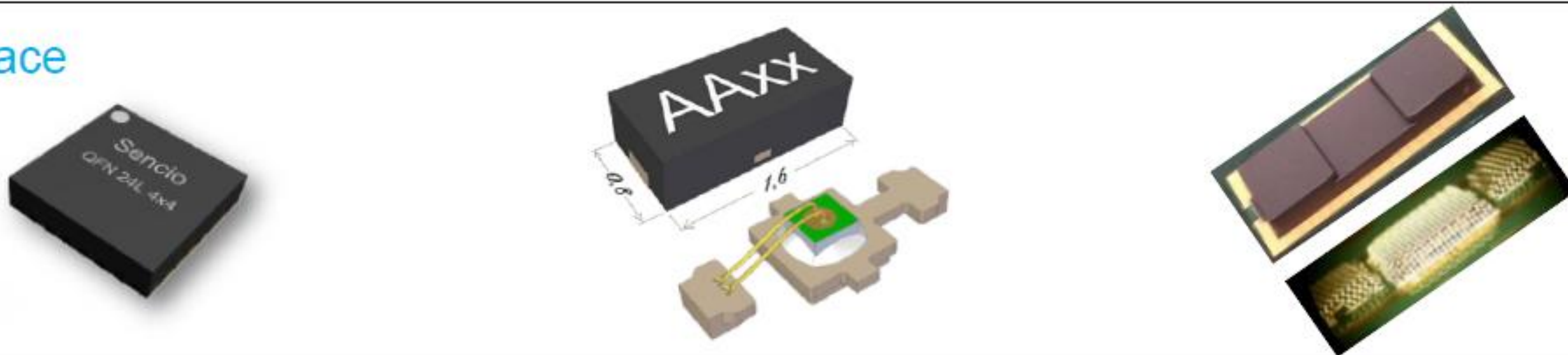
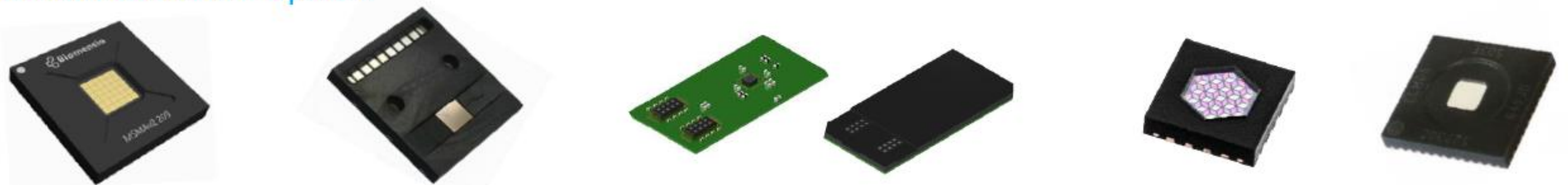
Automotive

RF / Radar / Space



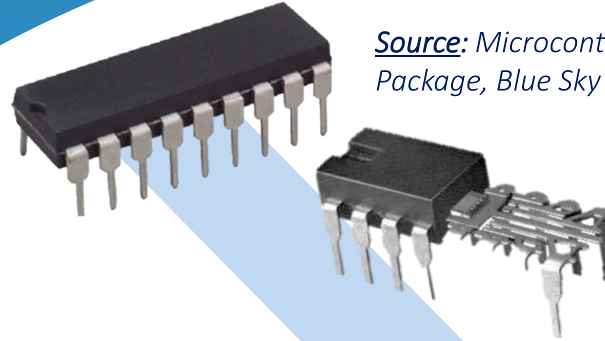
Industrial / Medical / Optical



semi

SEMI INTEGRATED PACKAGING, ASSEMBLY & TESTING

ESPAT

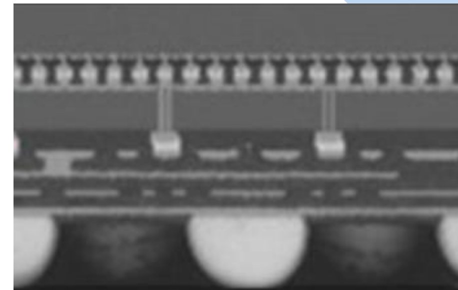


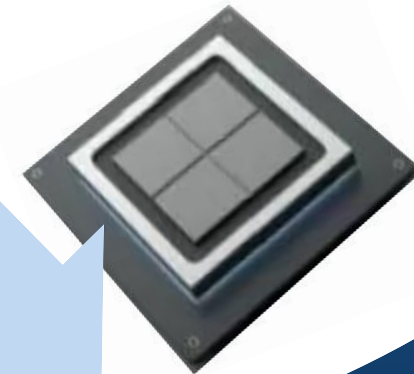
Source: Microcontroller PIC16F88 in DIP PTH Package, Blue Sky Components Limited, UK

Packaging, Assembly and Test in Europe

Landscape – Positioning – Challenges

Source: "Intel FOVEROS Architecture" Packaging IFTLE 421 - July 2019, Phil Garrou (Courtesy of Intel)



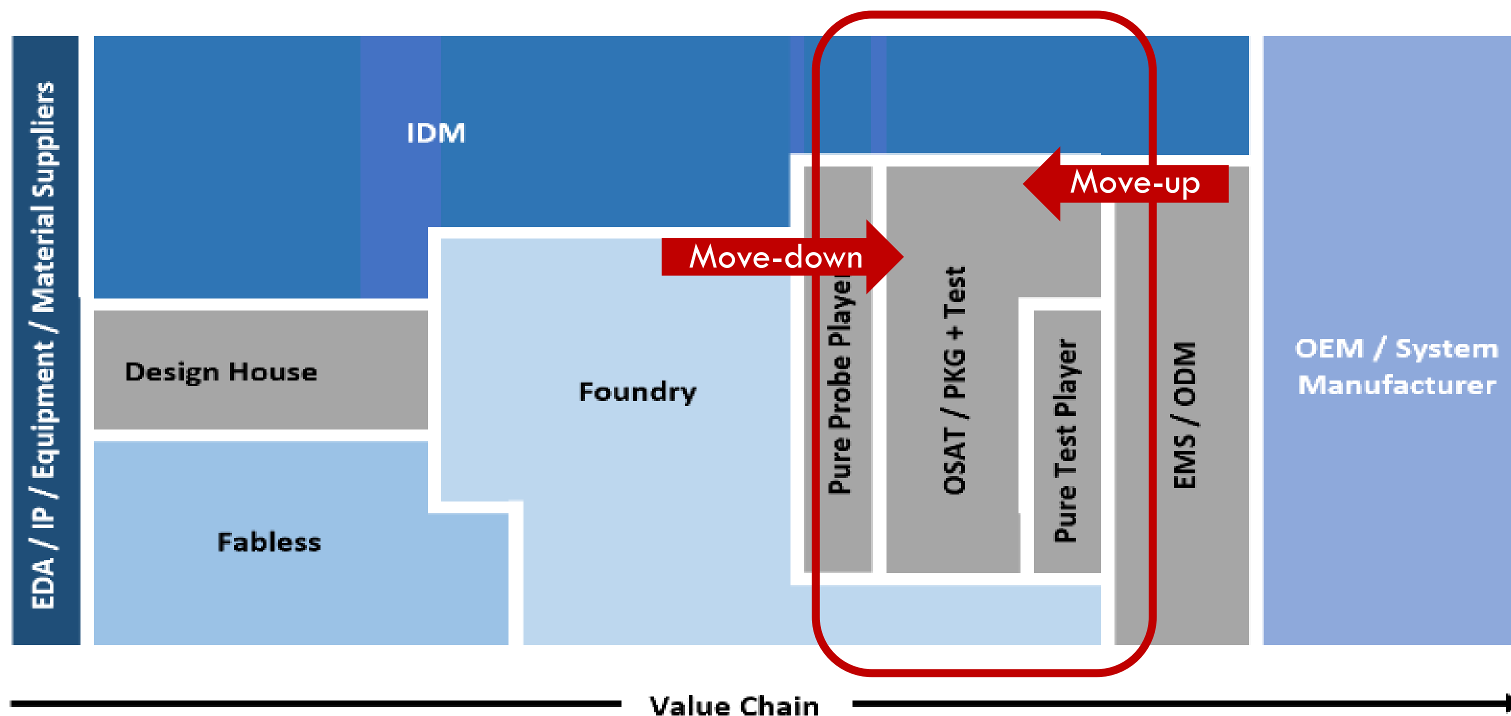


NOV/16, 2022

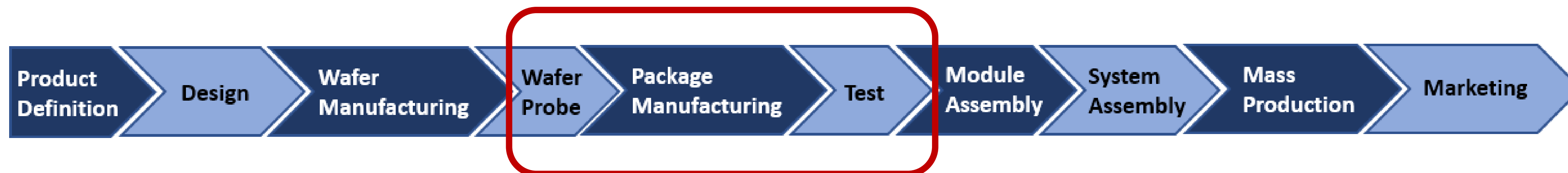
SEMICON Europa, Munich, Germany

Semiconductor Supply Chain

Position of OSATs/ SPAT-Service Providers

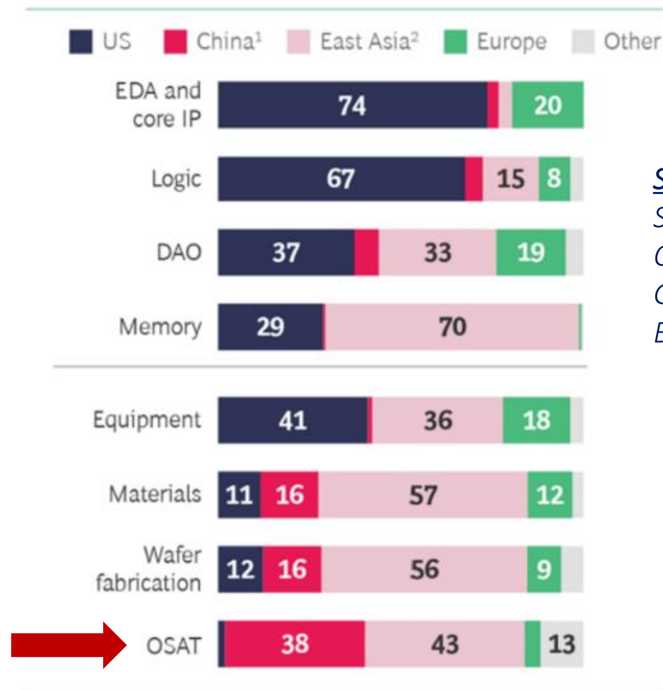


- **EDA** – Electronic Design Automation
- **IP** – Intellectual Properties, Design Blocks
- **IDM** – Integrated Device Manufacturer
- **OSAT** – Outsourced Semiconductor Assembly and Test
- **EMS** – Electronics Manufacturing Services
- **ODM** – Original Design Manufacturer
- **OEM** – Original Equipment Manufacturer



Worldwide OSAT Landscape

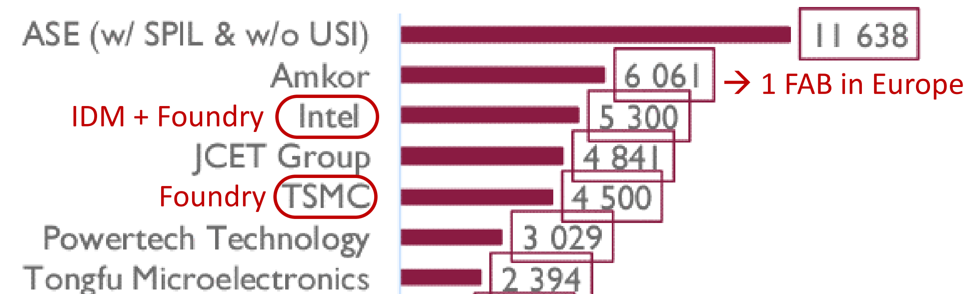
Outsourced Semiconductor Assembly and Test



Source: "The Global Semiconductor Supply Chain based on Geographic Specialization", BCG analysis, 2019

Europe: < 3%

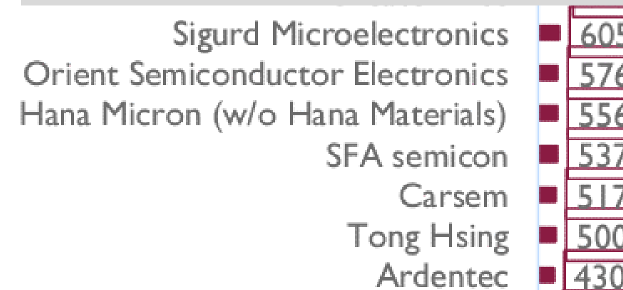
DAO = Discrete, Analog, and Other (including optoelectronics and sensors);
EDA – electronic design automation);
1) Mainland China, 2) East Asia including South Korea, Japan, and Taiwan.



2021 total SPAT market **$75B**

OSAT portion **$39,5B**

Expected 8% CAGR 2022-2027



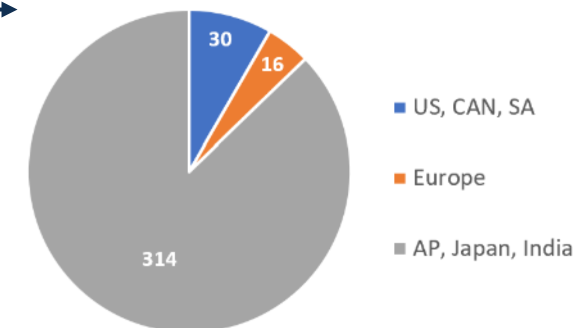
No European OSAT in the Top 50+

Source: "Top OSAT Ranking by 2021 Revenue [$M] – Intel and TSMC added", Advanced Packaging Quarterly Market Monitor Q1 2022, YOLE Développement

European OSAT Landscape

Independent Europe-headquartered OSATs/ SPAT-Service Providers

- SEMI “Worldwide OSAT Manufacturing Sites Database, 2019”
  - 360 facilities (120 companies), Europe 16 facilities (15 companies) only
  - ESPAT-Study: 90 facilities (65 companies), largest have ~300 employees and ~40-60 Mio€ revenue

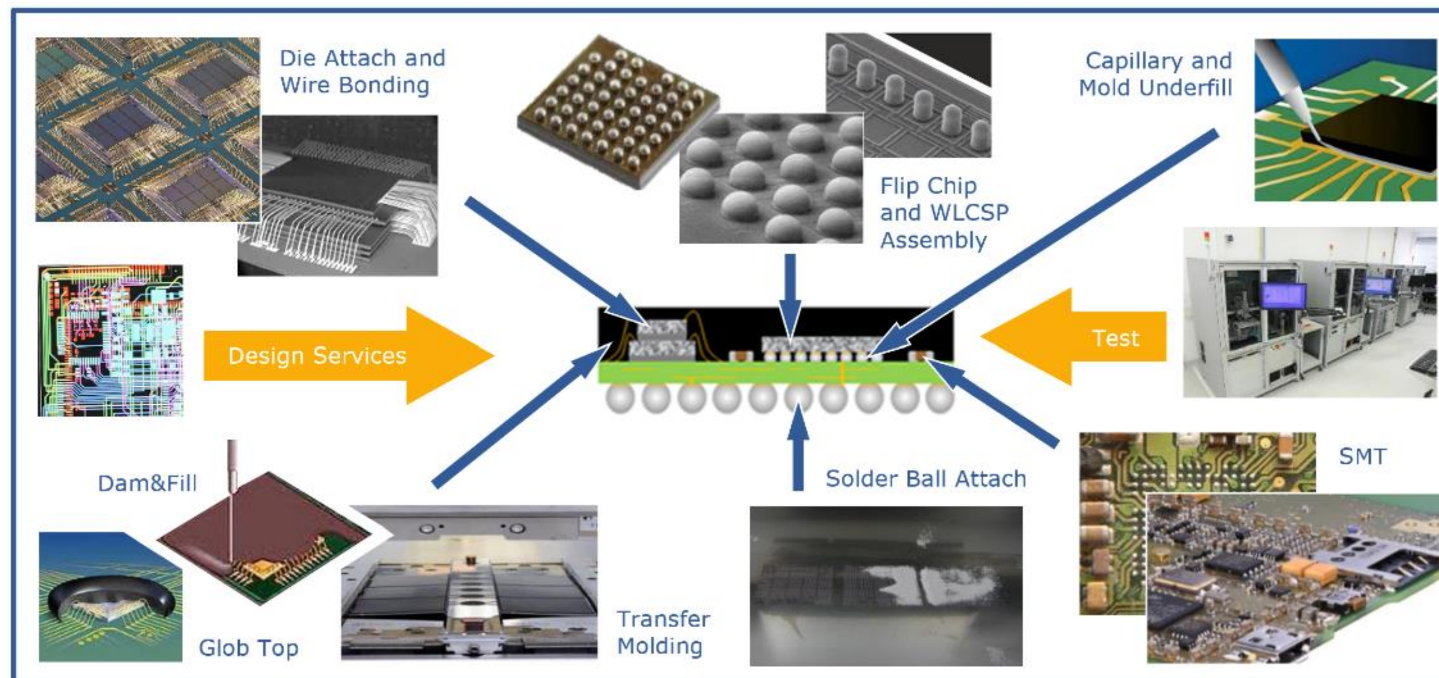


- Typically:
  High-Value Markets, Low/Medium Volumes, Specialized, Customized, Niches
- Markets:
  Medical, Healthcare & Life Science; Automotive & Mobility; Industrial & Automation; IoT, IIoT; Telecommunication Infrastructure; Aerospace & Aviation; Military & Defence
- Applications:
  Mainly Sensors & MEMS; Opto-electrical; Photonics; Hi-Rel; Power
- Market Size (SPAT total, including IDMs, Foundries, OSATs/ SPAT-SP) 2021: $75B → 2025: $85-110B
  - 2021 in Europe estimated < 3% ~ $2,2B
  - 2021 by Independent Europe-headquartered OSATs/ SPAT-SP addressed market estimated 10% = $220Mio

Advanced Packaging in Europe?

R&D - **YES** / IDMs - **YES** / Europe-headquartered OSATs - **PARTIAL**

- High Volume Mobile communication and Server/ HPC/ AI have been driving Advanced Packaging
- Technology gap in MFG has been growing in the last 3 decades w/ outsourcing of MFG to SEA



Example of typical Technology Toolbox of independent Europe-headquartered OSAT

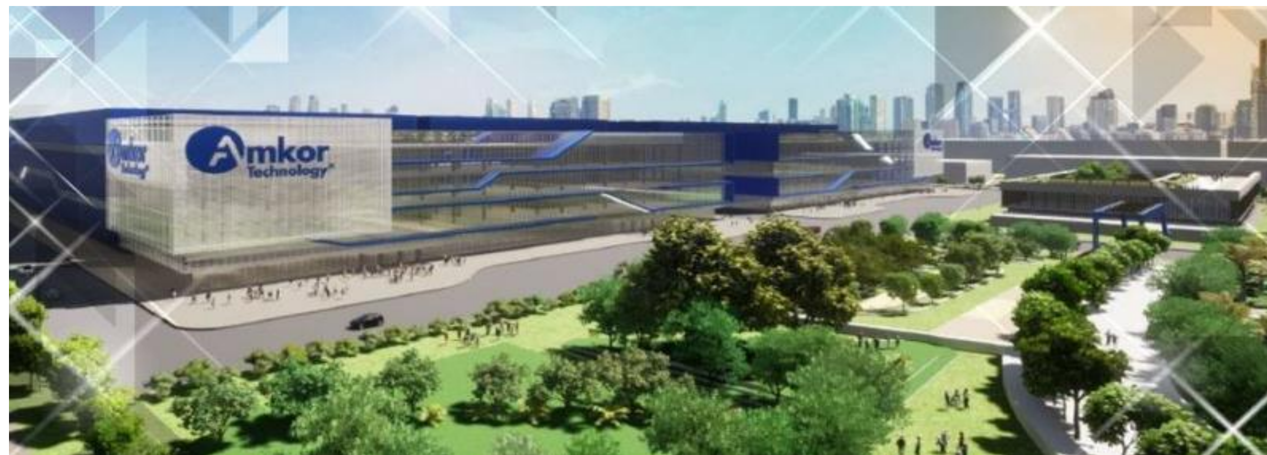
- UBM, Bumping/ SBA
- FlipChip (FC) Assembly
- CUF, MUF, NF-UF
- Stacked-Die WB Package
- System-in-Package (SiP)

- FP µbump and CuP FC
- WLP/ WLCSP (RDL)
- FO-WLP/ e.g. eWLB, InFO
- 2.5D/ TSV Interposer
- 3D/ TSV Packaging
- D2W, W2W
- Hybrid Wafer Bonding

Large OSAT Investments for Capacity Extension

Did you hear similar news from the US or Europe?

ESPAT semi



- **NOV/10, 2022: "ASE Breaks Ground on New Chip Assembly and Testing Facility in Penang, Malaysia (ASEM)"**
  - will be completed in 2025
  - will create 2,700 additional job
  - will comprise 2 buildings (Plants 4 and 5) with a built-up area of 982,000 square feet
  - ASEM will invest **$300 million over a period of 5 years** to expand its production floor space (w/ plant 4 and 5 total of 2 million square feet), procure advanced equipment, and train and develop engineering talent

- **NOV/21, 2021: "Amkor Technology, Inc. is growing once again: New factory in Bac Ninh, Vietnam (ATV)"**
  - will invest a total of $1.6 billion to develop a manufacturing, testing and assembling plant
  - will disburse **$520 million during the first five years**
  - 23-hectare plot, groundbreaking March/April 2022
  - project is due for completion in 2035

European OSAT Landscape

Changes by Regional Sovereignty/ Independent Supply Chain efforts

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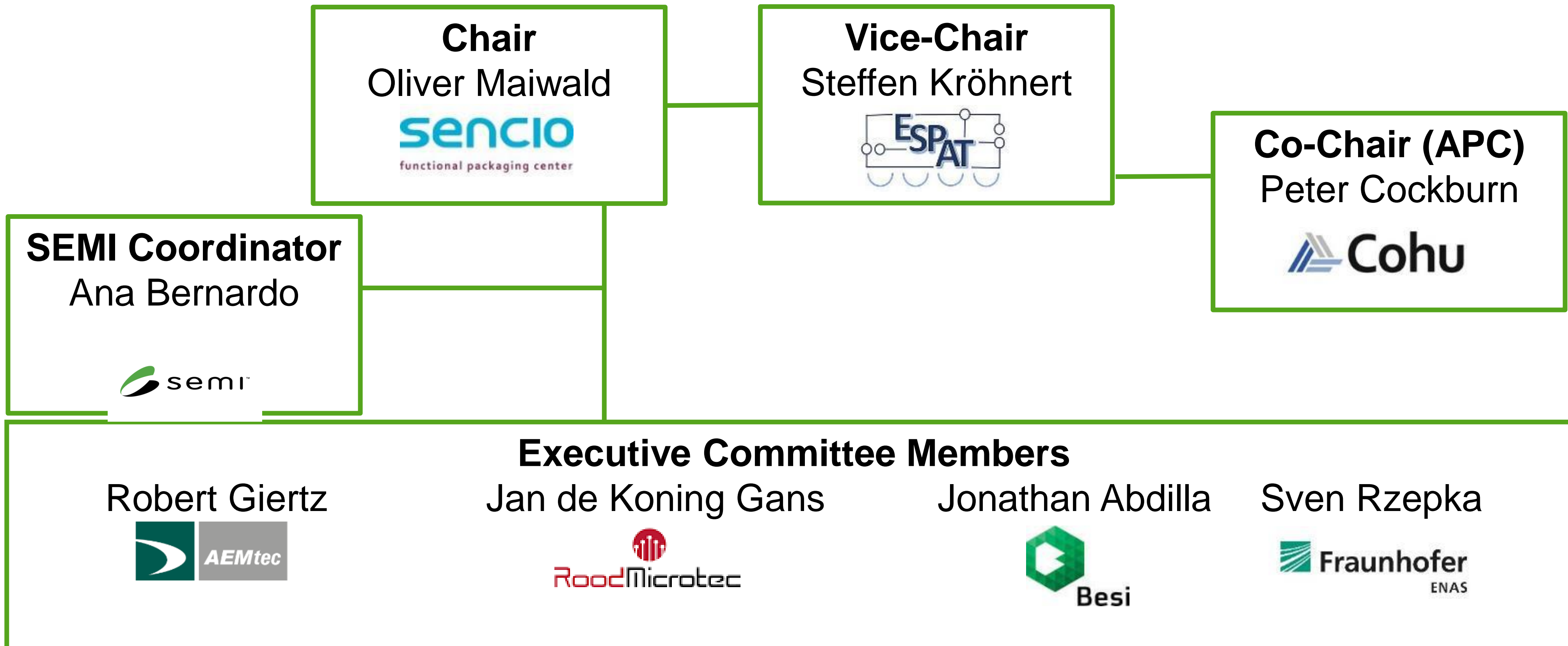
- **European-owned SPAT Manufacturing SMEs don’t have good chance to be considered by IPCEI ME/CT2, CHIPS Act**
  - Announced to support SMEs and Manufacturing too, but barriers are too high
  - Support given mainly to R&D, large IDMs, Foundries, multinational OSATs not headquartered in Europe and Suppliers
- **SPAT Manufacturing SMEs don’t have the size and financial backing to invest significantly**
  - High cost in Europe, low margin business, high level of competition in SEA, missing customer commitment/ volume guarantee
  - Need to close technology gap first before being able to offer the requested “disruptive new leading-edge technologies”
- **Only large OSATs can afford investments in e.g. Wafer Level Packaging (WLP) technologies (Fan-In and Fan-Out WLP/PLP)**
  - Thin-Film processing line, Redistribution layer (RDL) → Cost of a complete line between 50-80 Mio€
  - Partially UBM and Bumping in independent European OSATs/ SPAT-SPs available only
- **We need the support from IDMs, System Manufacturers, Integrators, Product Companies, OEMs**
  - Long term commitment, co-financing, funding, and volume guarantees to justify investments → RoI via line loading
  - If it is all about prices only, any effort is useless - This will not work!
    - Customer often expect “High Volume China Prices” for low and medium volume production in Europe
    - In good faith co-operations 2-3x higher price is generally accepted, some are at 8-20x today
      (depending on complexity, yield and quality requirements e.g. automotive Zero Defect, no repair)

European Chapter of SEMI integrated Packaging, Assembly, and Testing – Technology Community (ESiPAT-TC)



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ESiPAT-TC + APC SEMI Members

ADVANTEST · ASE · Besi · BOSCH · leti ceatech · Cohu · ESPAT

evatec process systems · Fraunhofer IZM · GlobalFoundries · Henkel · iMAPS · imec embracing a better life · infineon

JCET · MOMENTIVE · NXP · OSRAM · PacTech · ST life.augmented · YOLE Group

3dis technologies · APC · AEMtec exceet · AFORE · Amkor Technology · aptasic · ATOTECH · Besi · First Sensor

Fraunhofer ENAS · Fraunhofer IZM · FRT · HSEB Nothing stays unseen · imec · JSR Micro · MICROTEST · PacTech · PRESTO Engineering

RoodMicrotec · sencio · swissbit · unity sc

SEMI INTEGRATED PACKAGING, ASSEMBLY & TESTING

How is the EU going to scale to 20% marketshare?

- Close/advance the technology gap
- Invest € 1.0 Billion of the EU-Chips ACT in OSAT not in IDMs which do assembly for themselves in EU
- Fund capacity growth with automation and robotics
- Allow funding for assembly tools and machines which can also be used for manufacturing
- Reduce tax on electrical power

OSAT / Product Cost structure

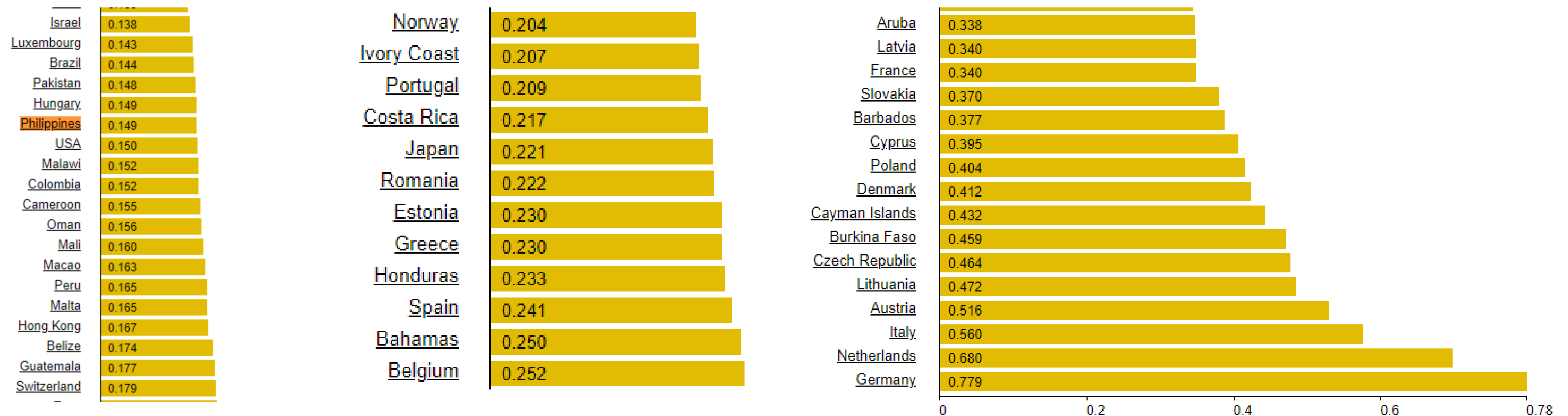
OSAT cost tructure	
assembly revenue	100%
equipment	18%
material cost	28%
transport	3%
salaries	40%
energy	6%
housing	4%
profit	1%

PULS	
Equipment	40%
Material	29%
Employee	31%
	100%

QFN 7x7 open cavity	
Equipment	40%
Material	40%
Employee	19%
	100%

Energy prices September 2022 ($/kWh)

- https://www.globalpetrolprices.com/electricity_prices/



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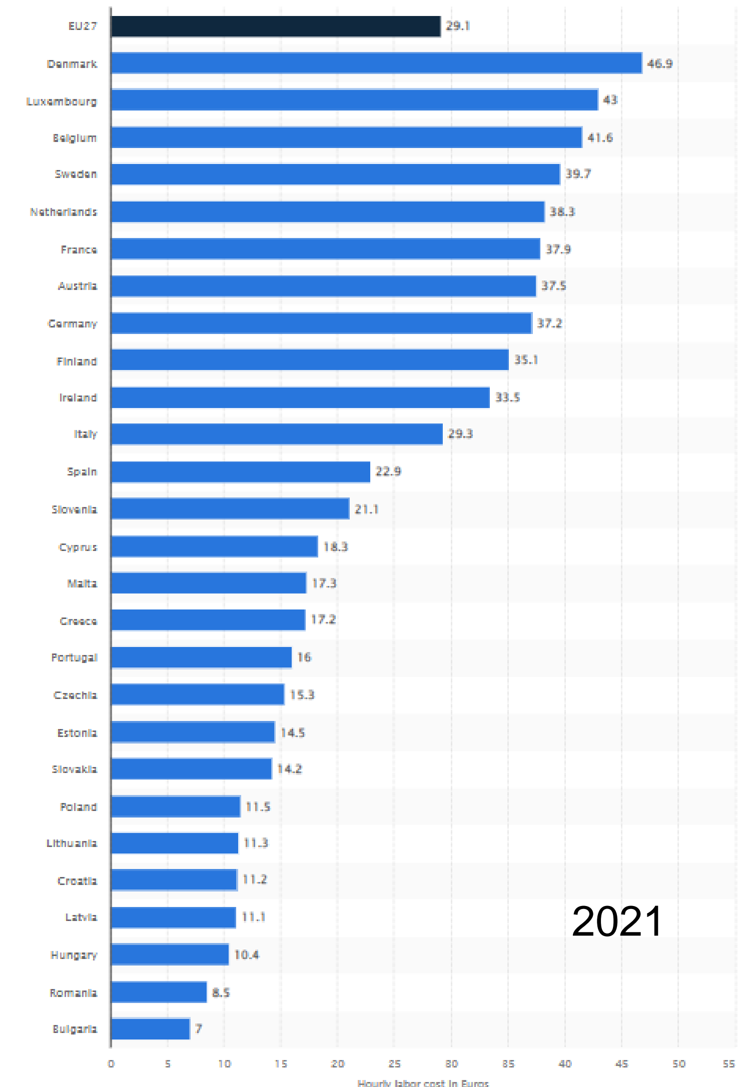
Salaries (hourly rates)

- The Netherlands: 38.3 €
- Germany: 37.2 €
- Romania: 8.5 €
- Thailand: 4.5 €
- The Philippines: 2.5 €



Example from US

International Microelectronics Assembly & Packaging Society

Workshop on

ONSHORING

ADVANCED PACKAGING AND ASSEMBLY

www.imaps.org/onshoring

July 10-12, 2023

Westin Tyson's Corner | Washington DC

"We are excited to bring together packaging and assembly supply chain stakeholders to discuss DoD onshoring initiatives. During the event, attendees will hear from DoD leaders and industry performers on current and future programs and participate in collaborative discussions to inform and address U.S. Government requirements for advanced packaging. This workshop serves as a unique opportunity to interface with multiple levels of Government leadership, the Defense Industrial Base, and Commercial Suppliers, all of whom share a common goal to reshore microelectronics manufacturing."

Brandon Hamilton - Booz Allen Hamilton
Onshoring Event Technical Chair

What is our NL/EU USP?

Innovation

- Customer and service oriented
- Complexity / creativity => Niche markets
- Non-commodity => Niche markets
- Customized => Niche markets
- Small / medium volume => Niche markets
- Edge of existing technologies => Niche markets

How can we, already in the beginning link packaging to chip design?

- Early stage involvement of package design
- Co-Development of assembly and IC design (e.g. pressure sensor)

- Create a tool set / guidelines for standard/customized packages which can be shared (PDK)

How can we convince local NL/EU companies to use local packaging?

- Mindset
- Octoberfest is more attractive than 4-daagse
- Pool of tools for standard packages at Sencio
- Optimal packages (cost efficient and high performance)

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Packaging workshop (https://europat.org/)

EuroPAT-WS 2023

Overview Registration Venue Exhibition Sponsors Agenda

SEMI INTEGRATED PACKAGING, ASSEMBLY & TESTING

SiPAT European Chapter

European Packaging, Assembly, and Test – Workshop 2023

06- 07 September 2023

more infos

European Packaging, Assembly, and Test – Workshop 2023

Aiming at facilitating mutual engagement, the **European Packaging, Assembly, and Test – Workshop 2023** will foster collaboration among semiconductor packaging, assembly, test manufacturing, and design experts along the complete semiconductor packaging supply chain, to collectively strengthen the semiconductor packaging eco-system in Europe.

Key topics presented

- European market and supply chain
- European OSAT industry capabilities
- Device and packaging manufacturers trends in challenging times

Highlights

- Exciting Exhibition
- Seminal Keynotes
- Invited Speakers
- Official visit to Sencio Facility
- Networking and business opportunities

Organized by:

sencio
functional packaging center

Sencio B. V.
Transistorweg 7,

sencio

functional packaging center

- Unique OSAT in Europe !!!
- One-Stop-Packaging solution provider
- Filling the gap between semiconductor and application