

# European Chips Act and the AHSI – FMD Pilot Line

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Research Fab Microelectronics Germany (FMD)

A cooperation between Fraunhofer-Verbund Mikroelektronik and Leibniz-Instituten FBH und IHP



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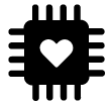


# From chip crisis to chip turnaround

## Situation in Germany and Europe



Germany is among the three export world champions



Semiconductors form the heart of a wide range of products



Europe is dependent on semiconductors from overseas



**Rethinking:** Designing and manufacturing in Europe for competitiveness and supply security



There's no digital without chips.«

Ursula von der Leyen,  
President of the European Commission

© Fraunhofer IIS / Kurt Fuchs

# Semiconductors are the motor of product innovation

## Example: Automotive Industry



Porsche 911 in 1978

vs.



Electric vehicle in 2023

**1**

Control unit

**8**

Semiconductor Chips

Electronic for motor control and some comfort functions

**50-90**

Electronic control units

**5.000-7.000**

Semiconductor chips

Electronics integral part of vehicle, ADAS, e-powertrain, AI...

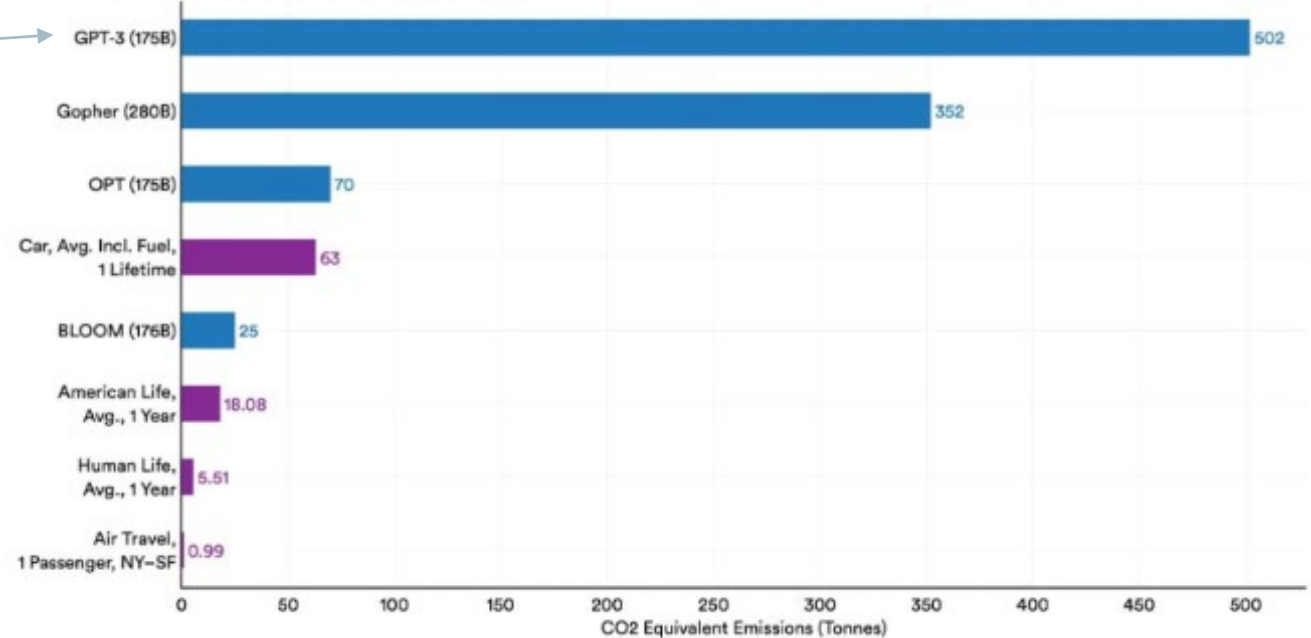
Semiconductor technology continues to drive innovation in consumer and professional applications

Bilder/Daten: Pixabay, Porsche AG



**CO2 Equivalent Emissions (Tonnes) by Selected Machine Learning Models and Real Life Examples, 2022**

Source: Luccioni et al., 2022; Strubell et al., 2019 | Chart: 2023 AI Index Report



Source: <https://www.nextbigfuture.com/2023/02/what-to-expect-for-openai-gpt-4-and-gpt-5.html>

- More compute power, faster compute units (e.g. 10000s of A100s w/80GB HBM2e, 400W)

- Improved energy efficiency of compute, data transfer & cooling required

# EU Chips Act, Nov. 30th 2023

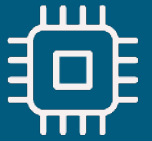
## Implementation via 3 Pillars

### *The EU chips act aims to:*\*

- ensure **large-scale capacity building** and **innovation** within the EU
- ensure that the EU is **self-supplying** to a much greater extent
- ensure that the EU can **react quickly** in the event of supply crises

#### Pillar 1

»Chips for Europe Initiative«  
Strengthening research, development and innovation



#### Pillar 2

»Security of Supply«  
Support for new types of production facilities and EU foundries



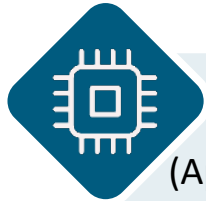
#### Pillar 3

»Monitoring and Crisis Response«  
Coordination mechanism for monitoring the supply of semiconductors



# Pillar 1: Chips for Europe Initiative

## Strengthening research, development and innovation



(Approx. **11 B€ public investments**, EU and MS)

- Bridge the gap from lab to fab
- Creation of large innovation capacities and technological capabilities in semiconductor industry
- Acceleration and adaptation to innovations



Capacity building for cutting-edge technologies (approx. 3.3 B€ contribution by 2030), in particular:

- **Infrastructure for design and system integration**, network of design centers, design libraries.
- **4+ pilot lines** (FD-SOI 7nm, GAA-FET 2nm, *Advanced Heterogeneous 3D-Integration and Advanced Packaging*, WBG electronics).
- Network of **qualification and competence centers**, interface with end users, SMEs and start-ups.
- **Work Force Development**, dedicated training
- Standardization to certify „green“ & „trustworthy“ ICs
- **New capacities** for the next generation: **quantum chips**, design libraries for quantum chips, pilot lines and TEFs for quantum technology.

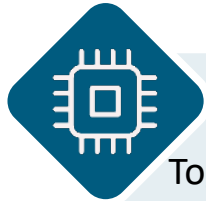


**European Chips Fund (2 B€) (separate budget line) for startups, risk capital, ...**

Implementation primarily via  
"Chips Joint Undertaking (JU)"  
- expansion of the current  
Key Digital Technologies JU

# Pillar 2: Security of Supply

## Strengthening research, development and innovation



Together with Pillar 1 and Pillar 3 totalling to 43bn

- Open EU foundry
- Integrated production facilities

▪ Details t.b.d



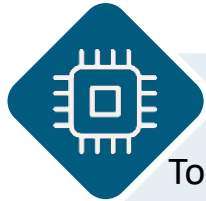
Ensuring resilience against supply chain crisis:

- **Incentivize public support for the installation of first of a kind facilities up to 100%**
- **IPFs:** vertically integrated companies to build advanced semiconductors (FrontEnd), equipment or key components
- **OEF:** Open Access to EU Stakeholders, dedicating a certain quantity of capacity to fabless EU companies
- **Collaborating with the Pilot Lines as of Pillar 1 to bridge the gap between advanced R&D and manufacturing**
- **Labelling of Design Centers of Excellence**

<https://ec.europa.eu/newsroom/dae/redirection/document/101723>

# Pillar 3: Monitoring and crisis response

## Ensuring fast reaction to future supply chain crisis



Together with Pillar 1 and Pillar 3 totalling to 43bn

- Monitoring
- Crisis Response
- Governance

▪ Details t.b.d



Ensuring a thorough understanding of the risks & mitigation possibilities for supply chain risks

- Strategic mapping of the EU's semiconductor sector, as well as dependencies on third countries and skill needs;
- Monitoring of early warning indicators resulting from the strategic mapping;
- Member States' reporting on the state of activities of key market actors in their territory;
- Mandatory requests to provide the Commission with information that is necessary to assess the nature of a shortage or identify mitigation measures.
- EU Commission acting as central purchasing body on behalf of Member States to procure products for critical sectors.
- Obligation for certain manufacturers to accept and prioritize orders to supply to critical sectors,
- Installation of a European Semiconductor Board (ESB)

Pharma

Energy

COVID



# EU Chips Act: Contribution of the fourmajor RTOs

**Pillar 1** »Chips for Europe Initiative«  
Strengthening research, development and innovation



**Pillar 2** »Security of Supply«  
Support for new types of production facilities and EU foundries

**Pillar 3** »Monitoring and Crisis Response«  
Coordination mechanism for monitoring the supply of semiconductors



R&D in microelectronics & semiconductors are the basis for technological sovereignty and the industrial future of Europe.

- Creation of a pan-European Pilot Line Facility by major European RTOs in the field: FMD, CEA-leti, CNR, imec with VTT, Tyndal, Graz, Forth, TNO and more
- Europe is an attractive and reliable location for investments in the production of semiconductor technologies.
- It is important that we talk to the industry about supply chain developments at an early stage so that we can avert possible crises in advance.

# FMD-AHSI pilot line – Motivation

## Heterointegration as a Key for Innovation in Europe

### New concepts for heterogeneous integration well beyond monolithic processes due to

- slowdown of Moore's Law
- demand for higher functional diversity.

### This requires a multi-layered approach integrating a variety of complementary technologies

- Chips using the 2-nm node technology as proposed in the Imec pilot line concept
- Chips of different FDSOI technologies from Leti
- Chips based on the technological approaches of other European RTOs and industries.

**based on Chiplets and novel Advanced Packaging Technologies.**

### The FMD-ASHI Pilot Line

- offers to European industry as well as R&D institutions innovation capabilities through advanced heterogeneous systems.
- has an **open access to customers and partners**, foster networking between the players and boost innovation ideas
- builds on **FMD's strengths in collaboration and joint innovation with extreme leverage for industry partners.**
- ensures a significant expansion in functionality and performance of the products from Europe and thus **pays off the goal of increasing chip production in Europe.**

# Target: Chip manufacturing in Europe at 20% of Global supply

## AHSI Pilot Line: Essential Component for the pan-European Pilot Line Facility

### New Quality:



#### Greater Market Pull

Expanded Interface for new applications through hetero-integration from chip design, PDKs, ADKs etc.



#### Accelerated Innovation

New chips and systems, faster validation of new processes and materials



#### Greater Technology Push

Prototyping for SMEs, Start ups and End User industries



#### Combining Technologies

for chiplet and system integration from various sources.

### „Innovation follows Research – Research follows Manufacturing“ - AHSI offers:



#### Work Force Development

through training and transfer of people



#### Easy access to

design platform and manufacturing platforms



#### Easy Access to

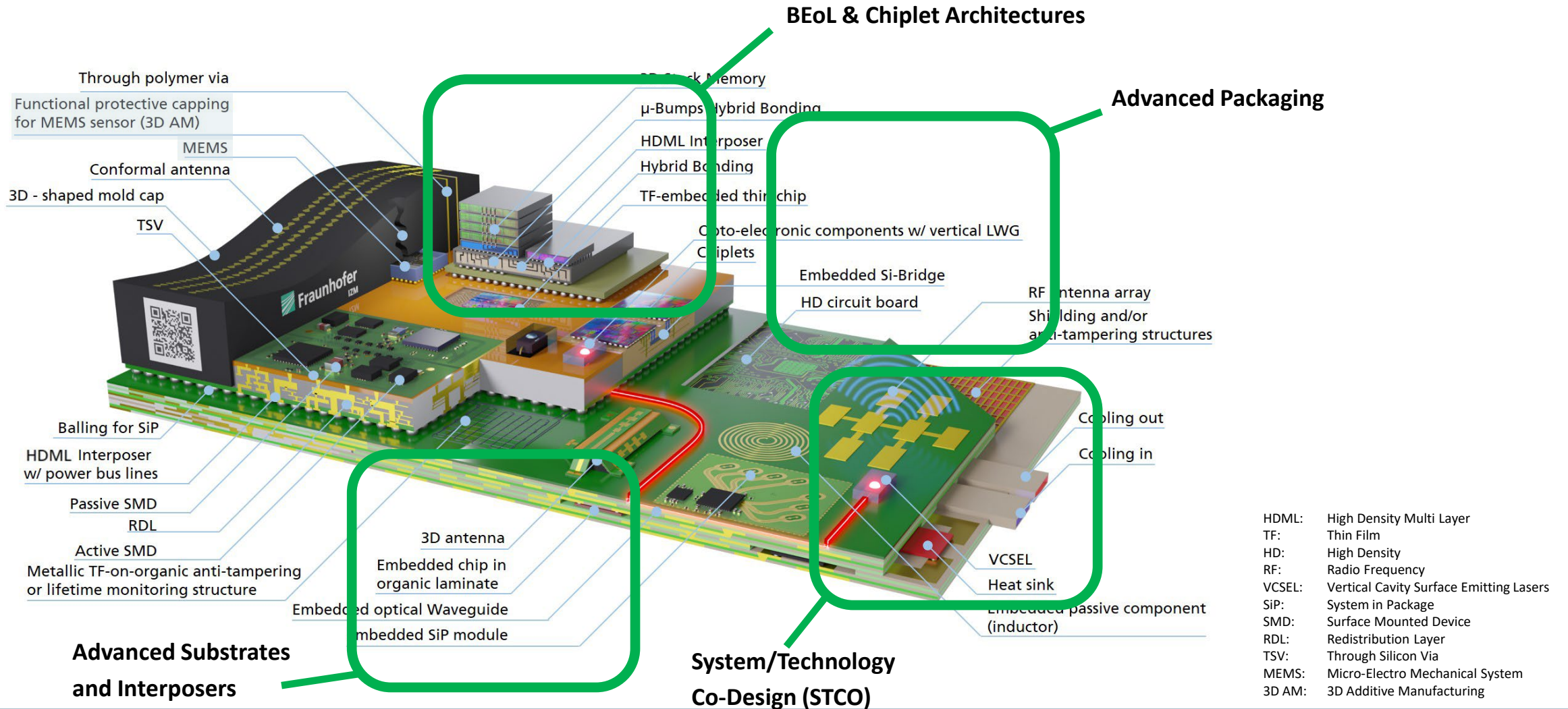
Chip prototyping and test



#### Integration of

European partners and RTOs with their own platforms

# Complexity of Advanced Heterogenous System Integration



# Key innovations of the AHSI pilot line by 2027

1

Worldwide first **advanced Automotive Chiplet Integration platform** (2.5D and 3D) for multiple core technologies (CMOS, Opto/RF) and non-electronic devices (MEMS, Opto, OLED), leveraging the innovations of advanced packaging

3

Expansion of hetero-integration into **quasi-monolithic integration (QMI) for highest performance density** by leveraging Back-End-of-Line and Advanced Packaging capabilities

5

**Novel testing concepts and technologies** for function-, quality- and yield- optimization

2

**Comprehensive end-to-end design flow and methodology** for chiplet-based advanced heterogeneous systems integration – Design-for-Performance, -Yield, -Power Efficiency, -Testability

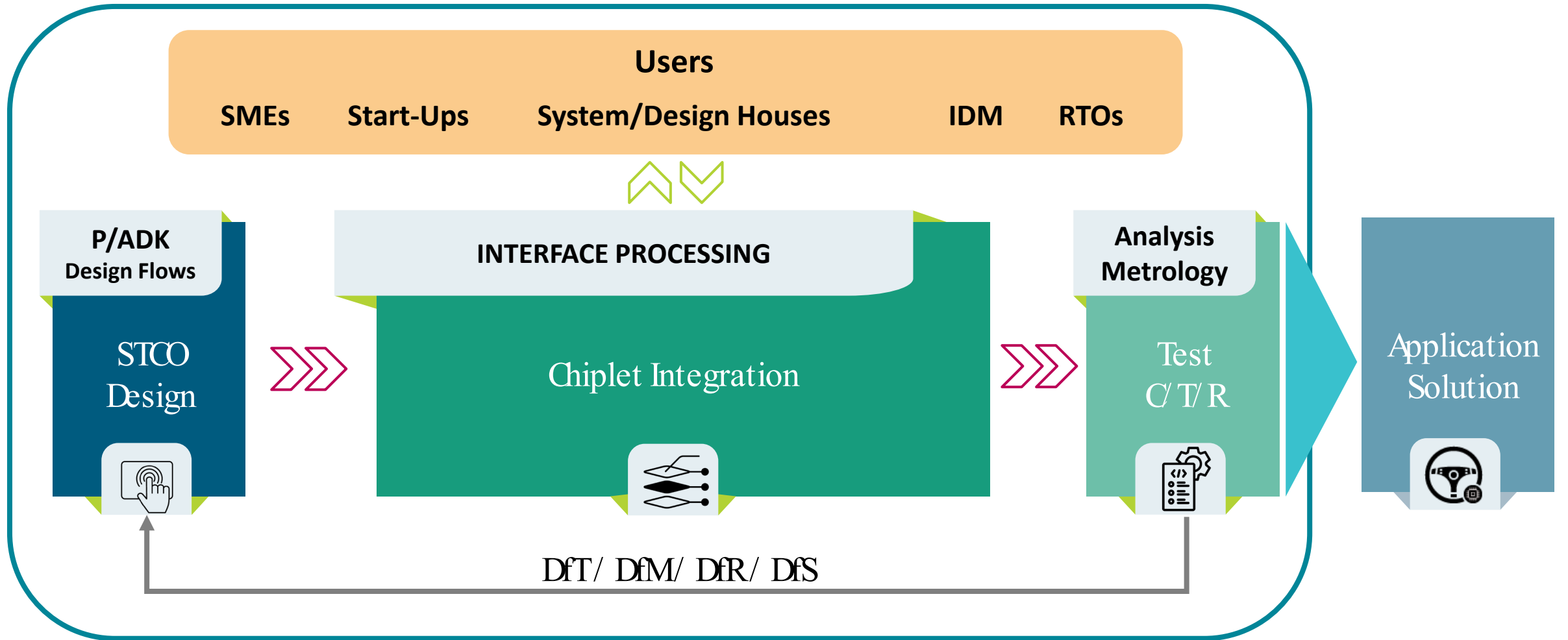
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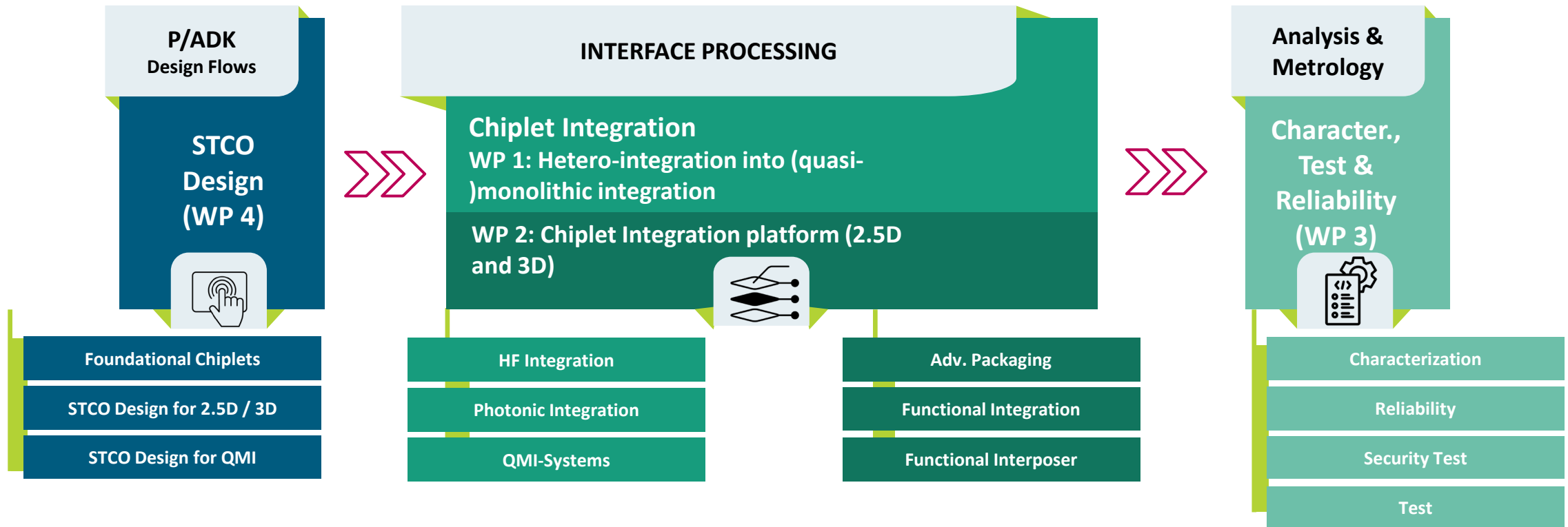
**Novel backend-of-line interfacing technology** for MEMS, opto/RF chips (III/V RF chiplets with (Bi)CMOS for 100 GHz+ frequencies)

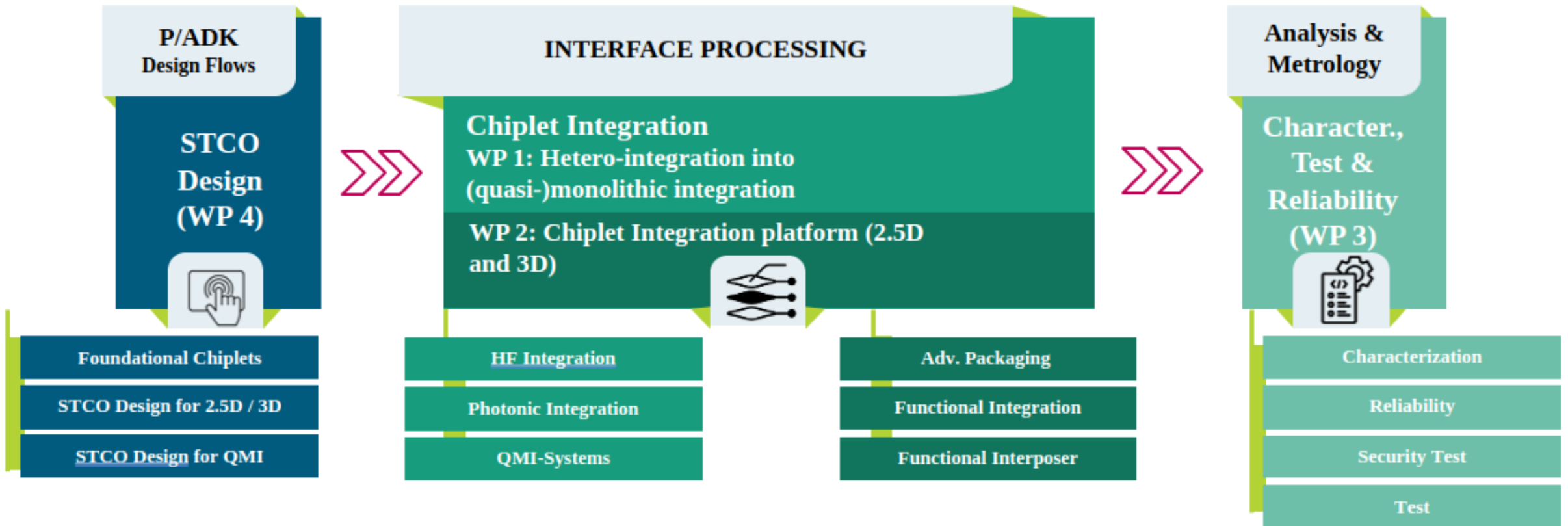
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Prototyping of **high performance chiplet-based systems for specific needs of the major European industries**, in particular, automotive, medical device and health care, sensors and advanced manufacturing industries

# Set Up for the FMD-ASHI Pilot Line

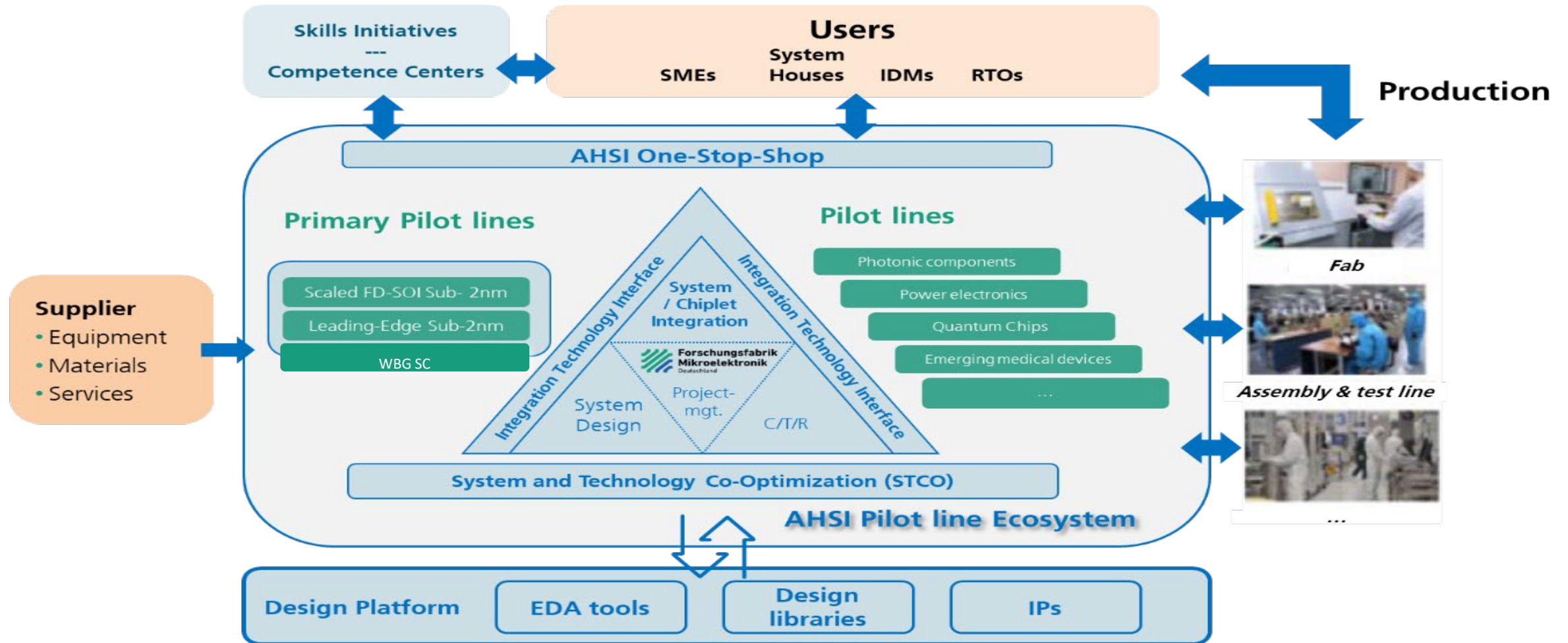








# Advanced Heterogeneous Systems Integration in the European Microelectronics Ecosystem



**Chiplet Interface Readiness for Heterogeneous Integration**

**Heterogeneous Integration Platforms (2.5D / 3D)**

**FMD Demonstrators**

**Interposer**  
200 mm  
Si / Polymer / Glas

**Interposer**  
300 mm  
Si

**Organic Interposer**  
Up to 600mm

Chiplets from external partners (RTOs, IDMs, Foundries,...)

FMD chiplets

Compute and Memory Integration

Photonics Integration

RF Integration

QMI System Integration

MEMS Integration

Characterization Test Reliability (CTR)

**STCO Approach**

**Design Topics:**

- Communication Interface IPs
- System Network Architecture
- Thermal / Power Management

**CTR Topics:**

- KGD Test Access
- In-Line Reliability Test Concepts
- Defect Analysis and Repairability

**Integration Topics:**

- 3D Stack (TSV, Bonding, ...)
- 2.5D Assembly + Overmold
- Bridge / Chiplet / Passives Embedding
- High Density Routing (I/s <5µm)
- E/O Routing (Polymer, SiN, ...)
- µ-Bump Scaling (pitch <5µm)
- Interface / Assembly Technology Mix
- High Throughput Assembly
- High Accuracy D2W <1µm
- Holistic Process Flow Approach (Chip-Interposer-Board)

Characterization Test Reliability (CTR)

**Demonstrators**

**Chiplet Interface Readiness for Heterogeneous Integration**

**Heterogeneous Integration Platforms (2.5D / 3D)**

**FMD Demonstrators**

**Interposer**  
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**STCO Approach**

**FMD Demonstrators + RTO Collab Demos**

Comprehensive Validation of

- Opto: D-Band Multi-Channel Transmitter with high shore line density
- RF: 6G Joint Communications and Sensing
- MEMS: Multi-material, high-performance sensing system
- Future HPC System (focus on high rel)

In cooperation with



Chiplets from external partners (RTOs, IDMs, Foundries,...)

FMD chiplets

Compute and Memory Integration

Photonics Integration

RF Integration

QMI System Integration

MEMS Integration

Characterization Test Reliability (CTR)

Characterization Test Reliability (CTR)

Demonstrators

# FMD-Advanced Heterogenous System Integration Pilot Line

## Low Volume Production – High Value Chips

### Stakeholder



Chip Foundries



Integrated Device  
Manufacturer (IDMs)



Materials & Tools  
Supplier



Semiconductor  
Customer



Research  
Community



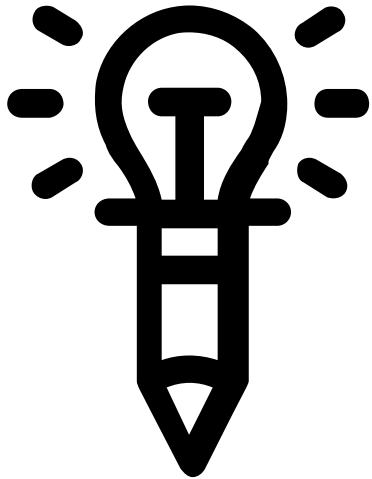
Start-ups

### Value Proposition

- **Design services to create and expand businesses**
  - **Design enablement** for chips, chiplet IPs, and systems to be manufactured in the AHSI Pilot Line
  - Provision and operation of **design platforms with corresponding support**
- **Process development, materials and tool validation**
  - Accelerated development of **technology and validated processes**
  - **focus on transferability** into commercial production lines
- **System development**
  - Use of AHSI technologies to **create new products and business offerings**
  - Easy access to specialized technologies for products of higher complexity
- **Outsourcing for manufacturing**
  - **Proof of Concept**, Demonstrators with high TRL / low volume production
  - **Prototype runs** and **small volume business**
  - Options to transfer high innovative products with volume forecast
- **Access to research facilities for Academia & European RTOs**
  - Support to expedite transfer of research results into applications
  - Easy access to AHSI Platforms via **local Member State Competence Center**

# FMD-Advanced Heterogenous System Integration Pilot Line

## Cooperation models & Open Access



- **Build strategically important technological capabilities for the innovation ecosystem**
  - contribution to technology sovereignty
  - “High Value & low Volume” production as first response to market failure
- **Support the build-up of these capabilities through public funding**
  - AHSI Pilot line builds upon a proven cooperation with industry
  - For the build-up: Close coordination with stakeholders in the innovation system (in particular industry) is a requirement.
- **Access to and use of the capabilities**
  - FMD takes the responsibility for long term and sustainable operation under its funding model
  - Baseline model for access is within the funding / operation model of FMD
  - Special models for cooperation (such as special technology lines, joint research labs, etc.) are possible depending on
    - individual agreements on risk sharing (for FMD)
    - commitment for funding / future business, etc., for industry partner



### Goals

- Presentation of the content of the **FMD pilot line AHSI**
- Presentation of the **value proposition** of the pilot line
- Incorporation of **feedback from key stakeholders** in the industry
- Call for a **strong v establishment of**
- Representative cl



### Format

- **Thematic Workshops:**  
Sensors/Actuators, Next Generation Power, Opto Semiconductors, High Frequency Systems
- 2h **Workshops per MS T**



### Standard Agenda

- **EU Chips Act**
- **FMD Pilot Line**
- **Testimonials** from industrial partners
- Query **industry feedback**
- **Discussion**

**CID is key to align ongoing work with the industrie's needs!**



### Common questions

- Do you consider the topics and set-up of the FMD pilot line to be **suitable to enhance innovation through microelectronics in Germany?**
- **Which topics are of particular interest to you** in the pilot line and which topics / aspects are missing from your point of view?
- Where do you see links for your company? **What kind of involvement could you imagine?**



### Documentation

- **Slide Deck**
  - EU Chips Act
  - AHSI pilot line
  - Details per Module
- Minutes and **statements of the participants**

# FMD-Advanced Heterogenous System Integration Pilot Line

## Contact



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