EIC Responsible/ Sustainable (Micro-Nano)Electronics

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Programme Manager at EISMEA (EIC)

April 26th 2023 WORKSHOP Sustainable Electronics

European Innovation Council

Disclaimer

"The view expressed in this presentation is the sole responsibility of the Programme Manager and does not necessarily reflect the views of the European Commission"

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- EIC Vision on Responsible/Sustainable (Micro-Nano)Electronics:
  - Role of the Programme Manager
  - Context and Trends
  - Examples of projects in the Portfolio
- EIC Digital Challenges
  - WP2023 Digital Challenges
- Conclusions

EIC Vision on Responsible/Sustainable (Micro-Nano)Electronics

The EIC Program Managers (PMs)

Role and Activities

The EIC Programme Managers

https://eic.ec.europa.eu/eic-communities/eic-programme-managers_en

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Carina Faber

Renewable energy conversion and alternative resource exploitation

Samira Nik

Quantum tech and electronics

Isabel Obieta

Responsible electronics

Antonio Marco Pantaleo

Energy systems and green technologies

Francesco Matteucci

Advanced materials for energy and environmental sustainability

Stella Tkatchova

Space systems and technologies

Iordanis Arzimanoglou

Health and biotechnology

Enric Claverol-Tinturé

Medical technologies and medical devices

Ivan Stefanic

Food chain technologies, novel & sustainable food

Franc Mouwen

Architecture engineering construction technologies

Programme Manager Priorities

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Identify candidate challenges and select portfolios of projects

Science and innovation intelligence activity

Outreach and community building

Guiding panel members to select portfolio of projects for Pathfinder, and active observers for Transition and Accelerator

Pro-active management of selected portfolios and projects

Common market analysis, contacts with investors, addressing regulatory barriers, access to specific infrastructure, standardization, common dissemination activities, alignment of project results with results of other projects (to build future value chains)

EIC Proactive Management

Role of the PM for Sustainable/Responsible (Micro-nano) Electronics

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- **Develop a Vision and challenges** in EIC WP that will create R&I&D opportunities for the EU SMEs and start-ups tackling not only more performant electronics but also looking at novel ideas to make them more environmentally friendly

- **Pro-active portfolio management** - create, manage projects portfolios and introduce EIC beneficiaries to potential partners, customers & investors and provoking the approach towards environmental sustainability

Methodology for Topics Selection

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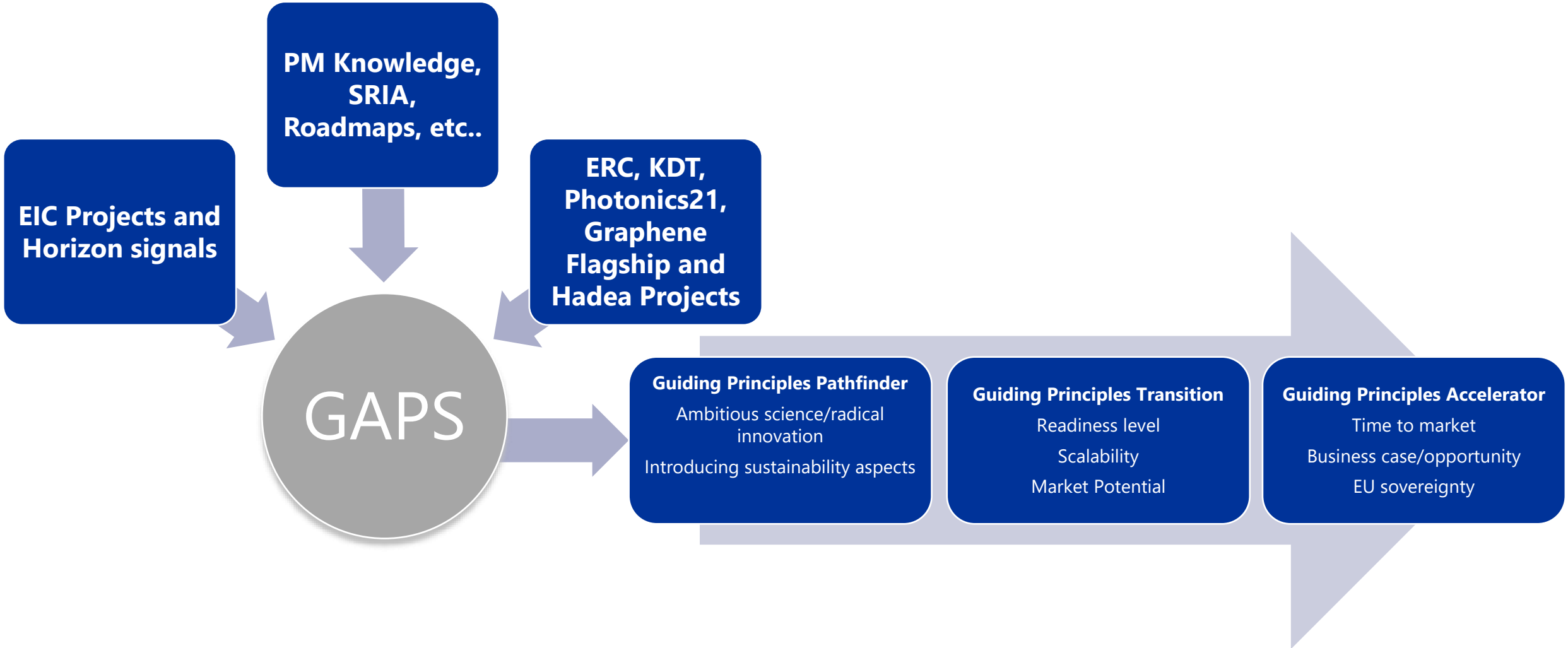

Context and trends

Context and trends

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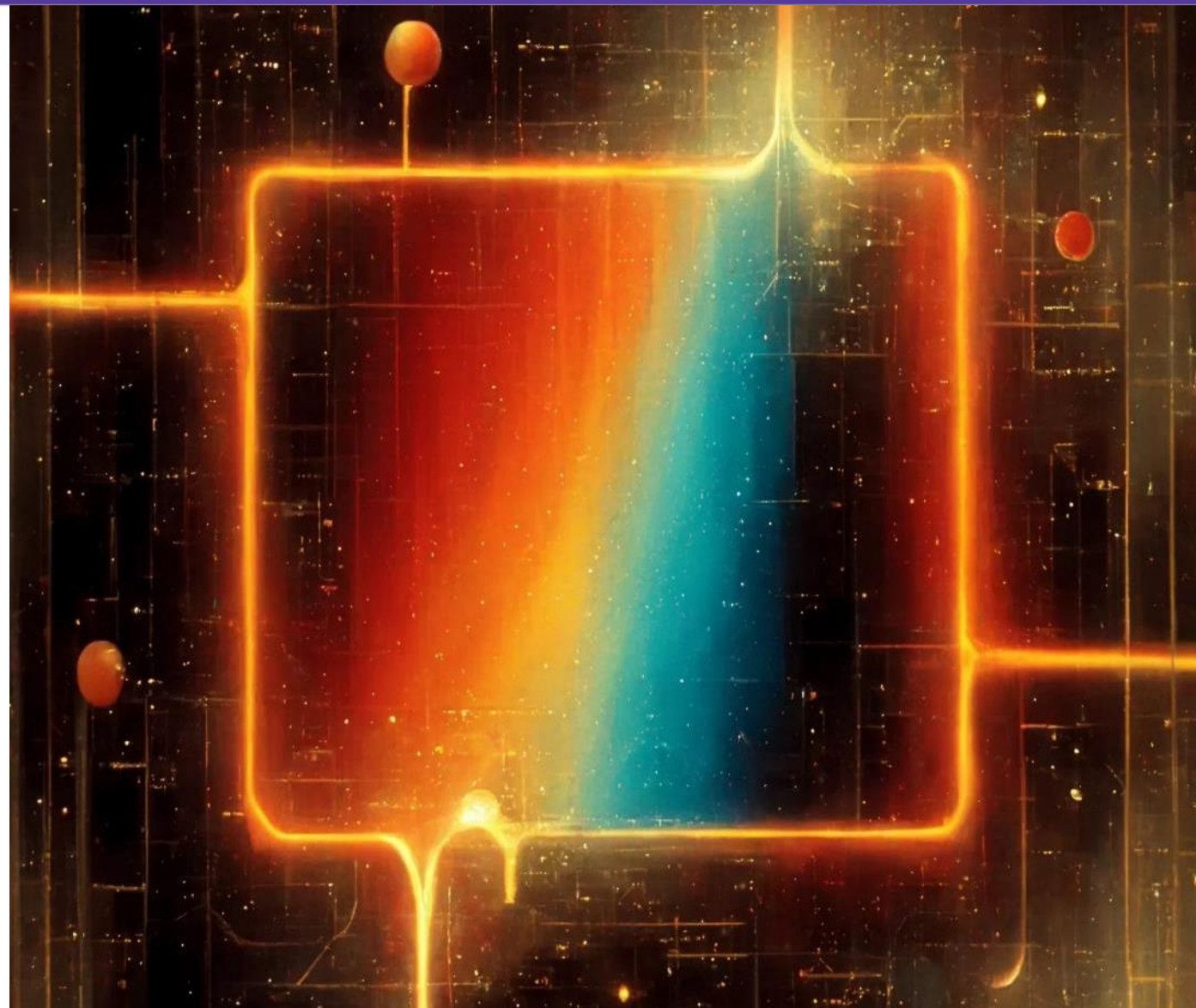
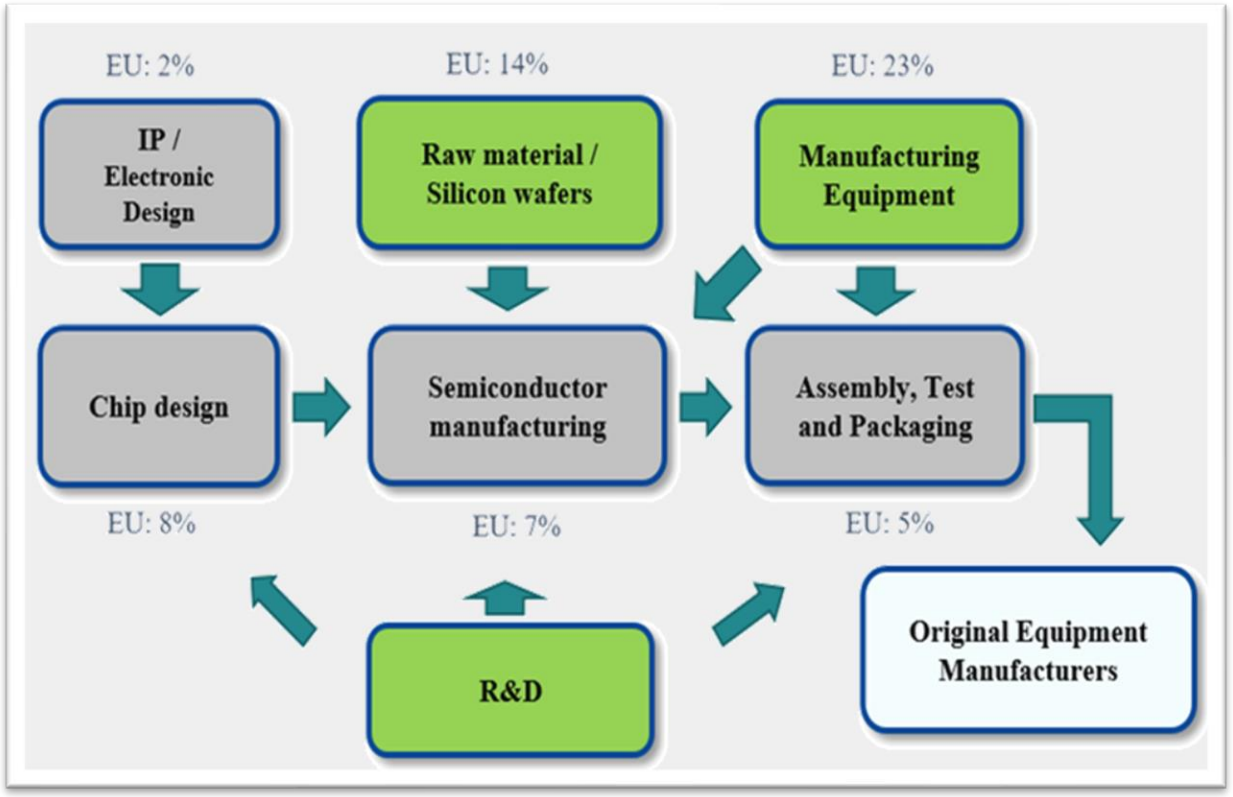
- **Chips Act:** Semiconductor shortage and EU sovereignty
- **Sustainability concerns in Semiconductors**: Raw Materials and other policies
- **Novel Functionalities** vs **More Moore**

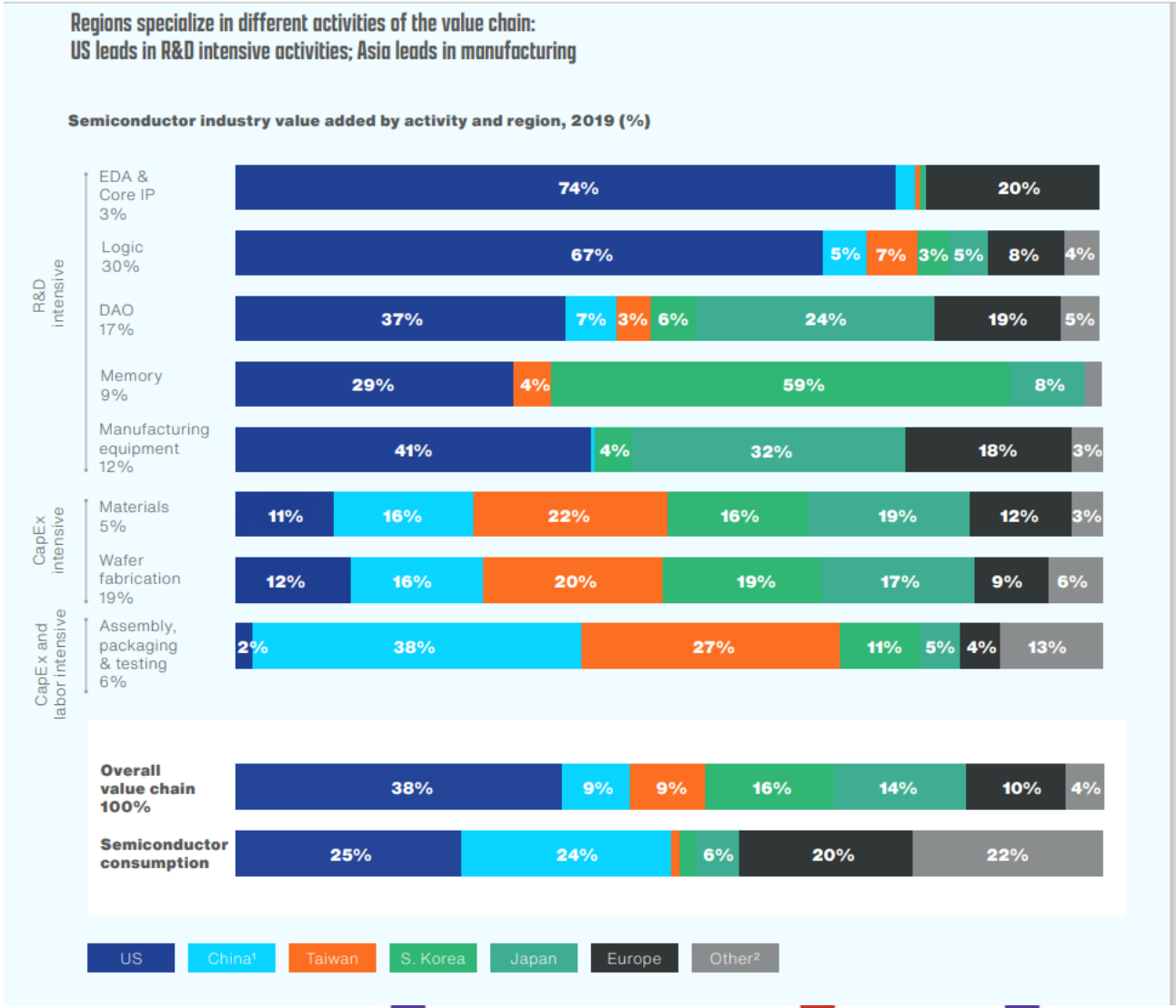


Chips Act

European Innovation Council



Source: European Commission. (2023). European Union Chips Act. Retrieved from [https://digital-strategy.ec.europa.eu/en/policies/european-chips-act]



Source: BCGxSIA April 2021

Chips Act and EU Sovereignty

European Innovation Council

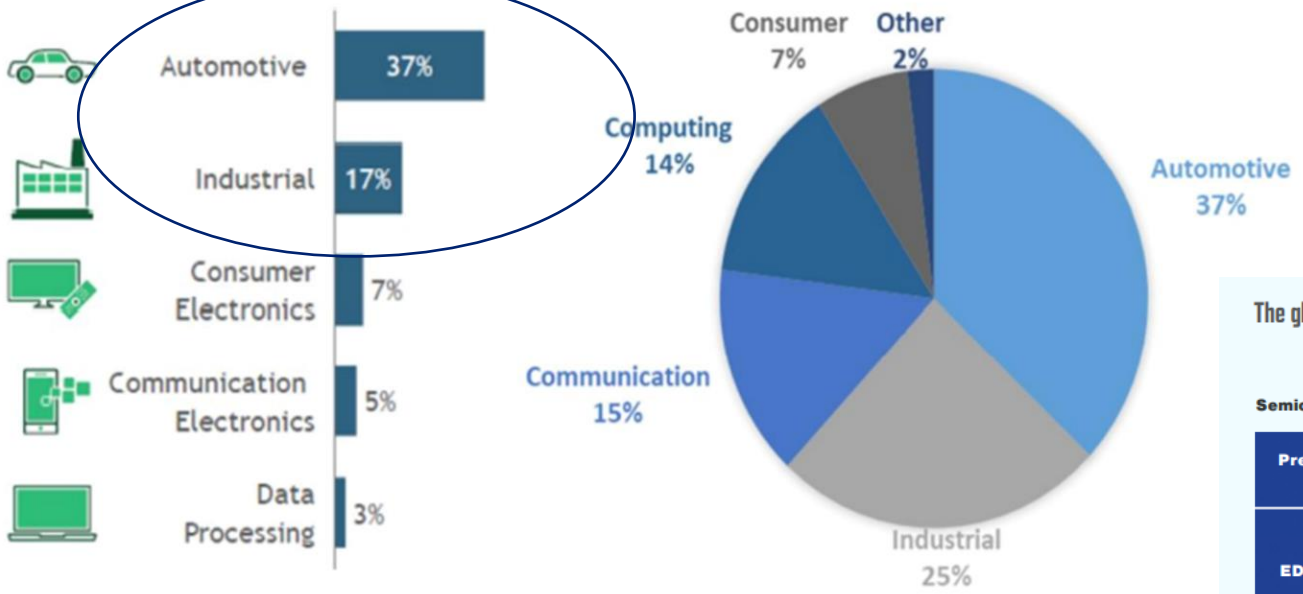
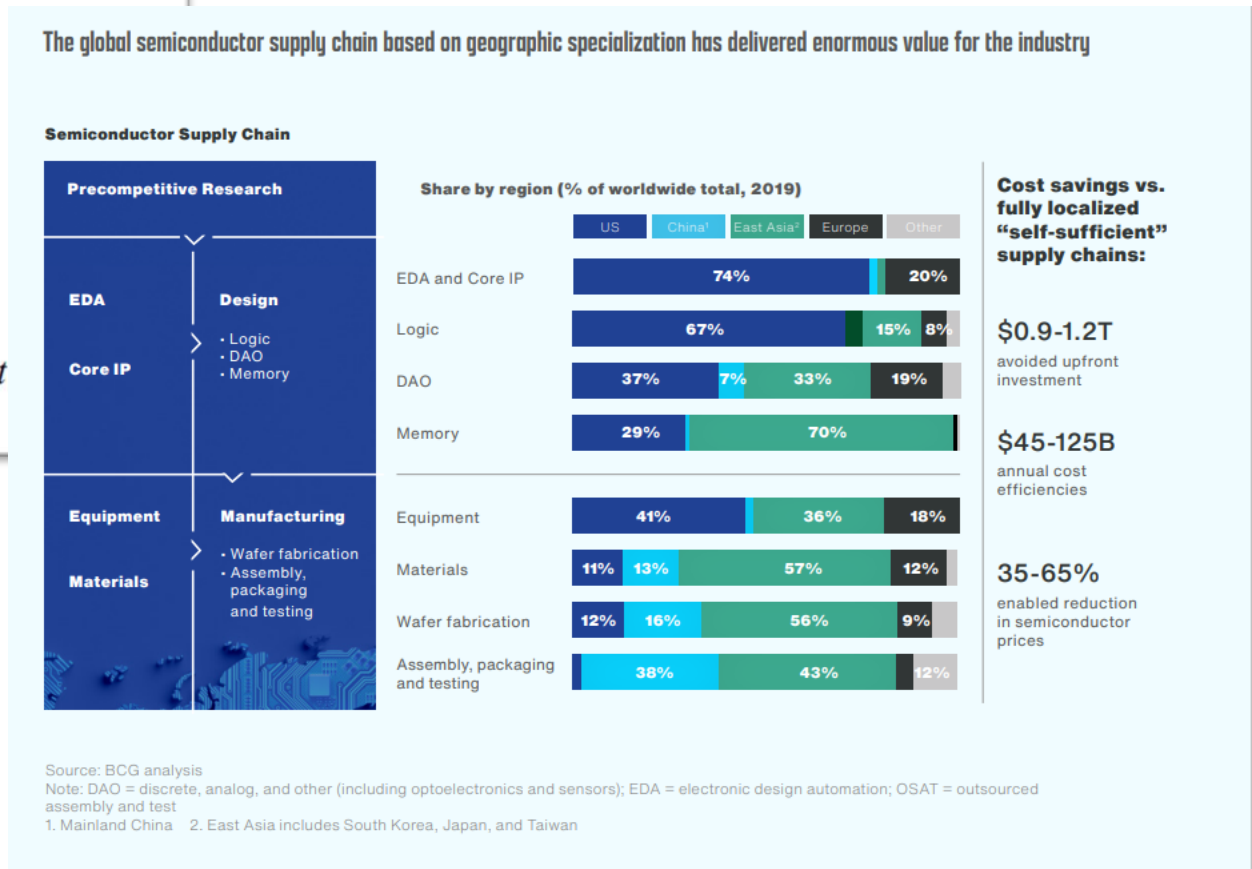


Figure 23. European share of semiconductor market segments, and demand by end market Decision, ZVEI, 2019)

Should we invest in the Automotive and Industrial Sectors whit a strong ecosystem in Europe or in segments with important growths like Consumer??

At device level, should we reinforce our position in DAO components or should we try to increase our share in the more demanding nodes?



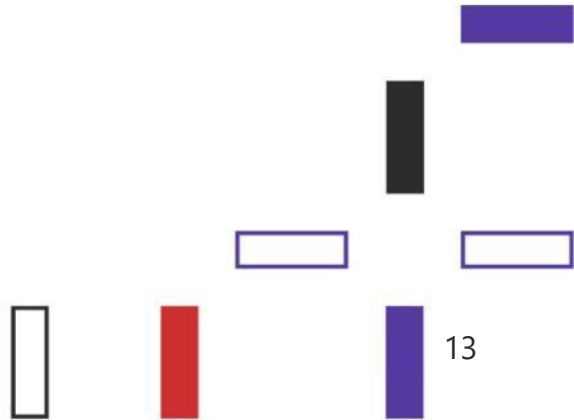
EIC and European Chips Act

European Innovation Council

EIC has a mandate of € 300 million to contribute to European Chips Act:

- Address semiconductor shortage
- Strengthen Europe's technological leadership
- Budget: € 43 billion
- Goal: 20% market share by 2030

For that some challenges will be dedicated to it



Sustainability in SEMICONDUCTORS

Design, manufacturing, use, repair, reuse, and recycling

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Design

Materials

Manufacturing

Integration

Policies

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- EU Circular Economy Action Plan [Circular Economy Action Plan | Subject files | Home | ENVI | Committees | European Parliament (europa.eu)]
- Critical Raw Materials Resilience [EUR-Lex - 52020DC0474 - EN - EUR-Lex (europa.eu)]
- Framework for 'Safe and Sustainable by Design' Chemicals and Materials [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32022H2510]

2020 Critical Raw Materials (new as compared to 2017 in bold)		
Antimony	Hafnium	Phosphorus
Baryte	Heavy Rare Earth Elements	Scandium
Beryllium	Light Rare Earth Elements	Silicon metal
Bismuth	Indium	Tantalum
Borate	Magnesium	Tungsten
Cobalt	Natural Graphite	Vanadium
Coking Coal	Natural Rubber	**Bauxite**
Fluorspar	Niobium	**Lithium**
Gallium	Platinum Group Metals	**Titanium**
Germanium	Phosphate rock	**Strontium**

	Aerospace/ defence	Textiles	Electronics
Antimony	✓	✓	
Baryte			
Bauxite	✓	✓	✓
Beryllium	✓		✓
Bismuth	✓		✓
Borate	✓		✓
Cobalt	✓	✓	✓
Coking coal			
Fluorspar			
Gallium	✓		✓
Germanium	✓		✓
Hafnium	✓		✓
Indium	✓		✓
Lithium	✓		✓
Magnesium	✓		✓
Natural graphite	✓		✓
Natural Rubber	✓	✓	
Niobium	✓		✓
Phosphate rock			
Phosphorus	✓		
Scandium	✓		
Silicon metal	✓	✓	✓
Strontium	✓		✓
Tantalum	✓		✓
Titanium	✓		✓
Tungsten	✓		✓
Vanadium	✓		
PGM	✓		✓
HREE	✓		✓
LREE	✓		✓

Trends: New functionalities and Scaling

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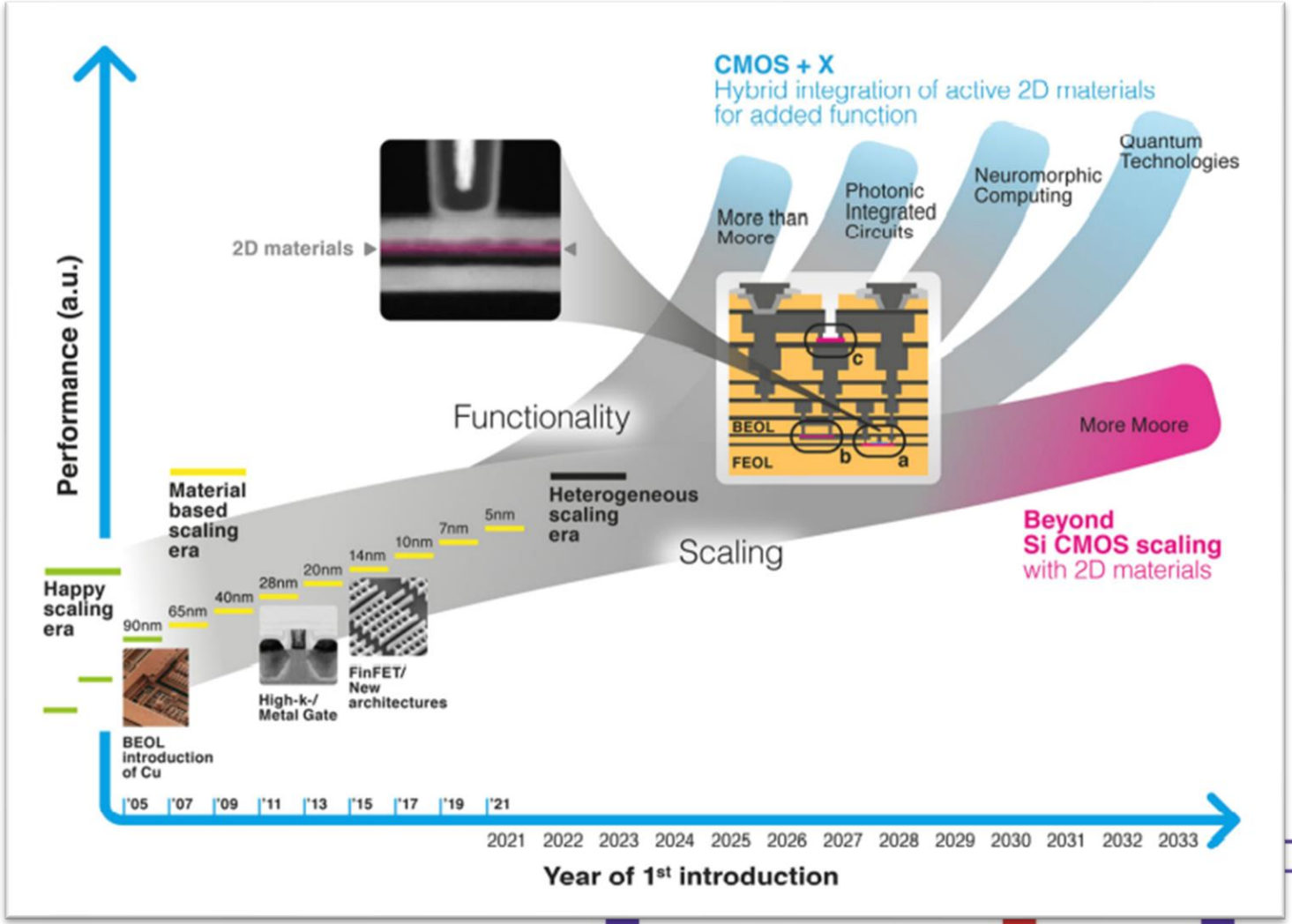
- **Start-ups play an important role in the novel functionalities**



2D materials for future heterogeneous electronics
NATURE COMMUNICATIONS | (2022) 13:1392

EIC "Responsible Electronics" Portfolio Examples

EIC Current Portfolio 2019-2022

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Cluster 1: Sustainability Arguments	Cluster 2: Devices	Cluster 3: Materials/Processes	Applications / Sector
Materials/processes for environmental sustainability	Communication/Logic/ Computing/Memory	**Metamaterials or Topological**	Mobility (including Automotive, Aerospace, ..)
Novel devices tackling reduction of power consumption in service	Sensors and Actuators (including Microfluidics)	**Additive processes and Thin Films**	Consumer
Solutions for extension of lifetime, easy-to-recycle/reuse, based on packaging, heterogeneous integration, etc..	Power Devices	**III-IV-V**	Industry 5.0
Others (when no sustainability arguments are introduced)	Optoelectronic/Photonic (including displays)	**Heterogeneous Integration**	Materials/Foundry
		Organic materials	
		2D Materials	

EIC Clustering 1 - Sustainability Arguments

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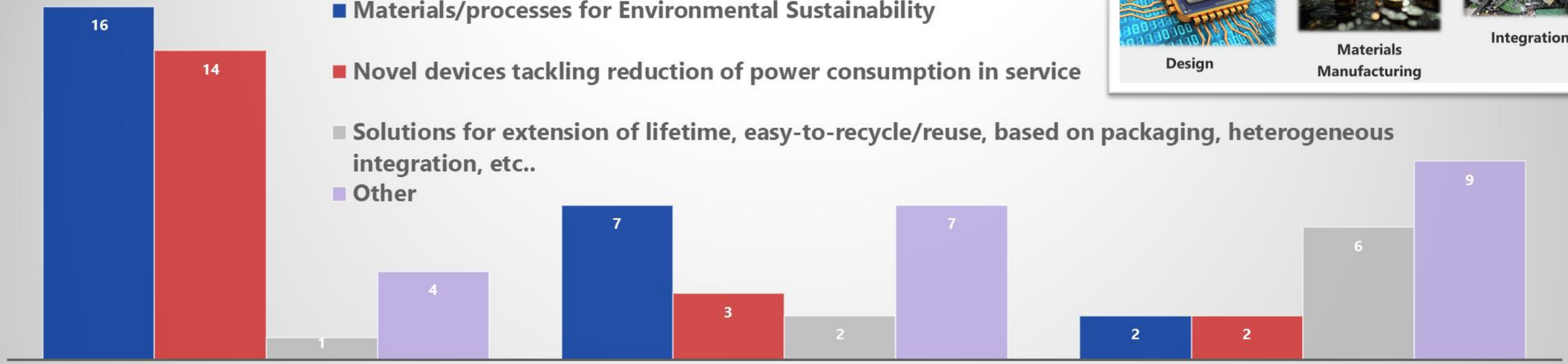
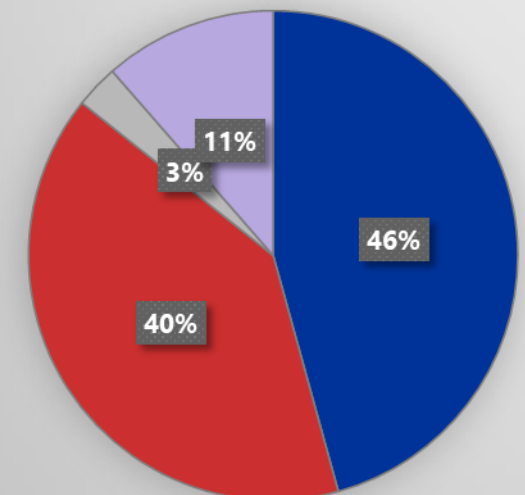
Design


Materials Manufacturing

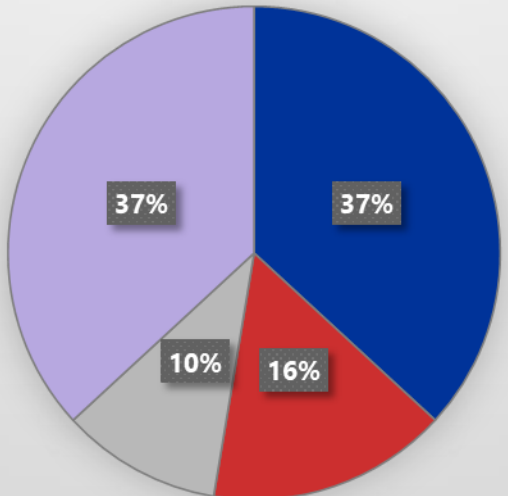

Integration



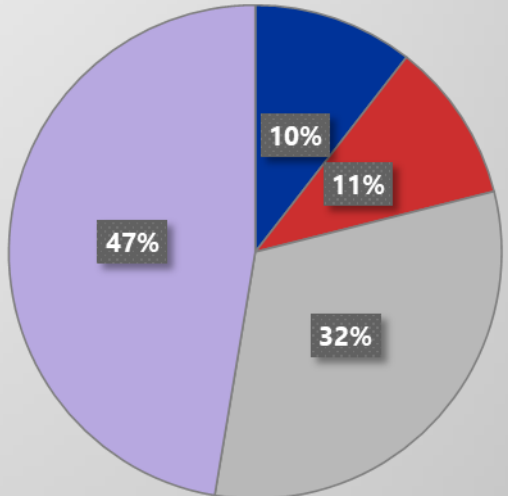
PATHFINDER



TRANSITION



ACCELERATOR



Clustering of Devices

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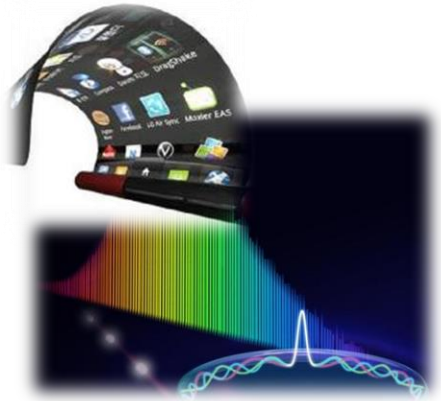
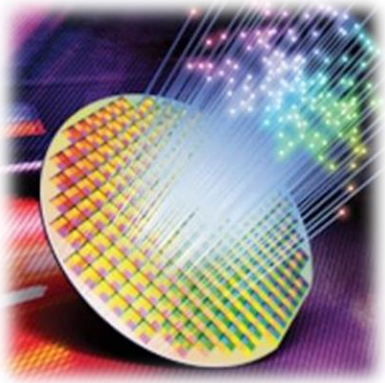
Sensors/Actuators

- Pressure
- Temperature
- Environmental



Photonic Optoelectronic Displays

- Flexible
- Integrated
- Low losses.



Memories

Logic

Computing

Communication

Power devices

EIC Clustering 2 - Devices

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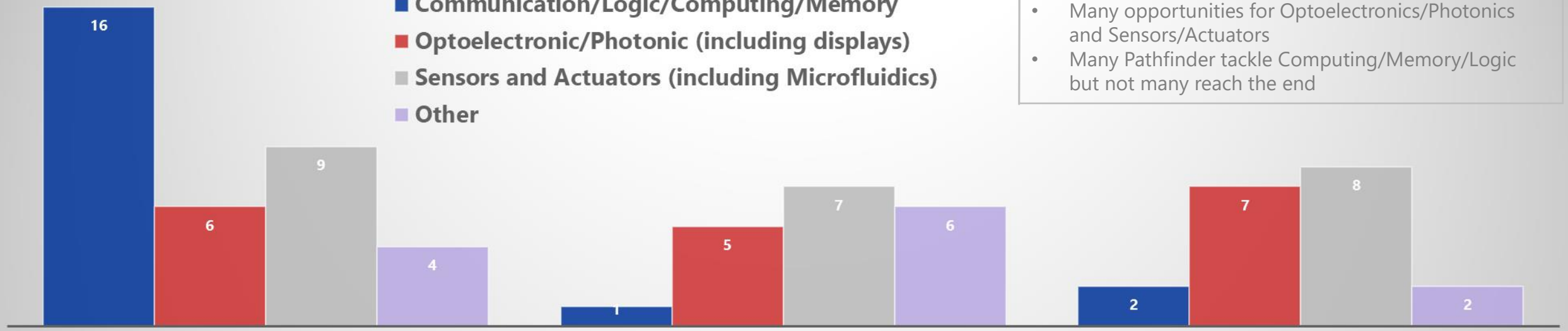
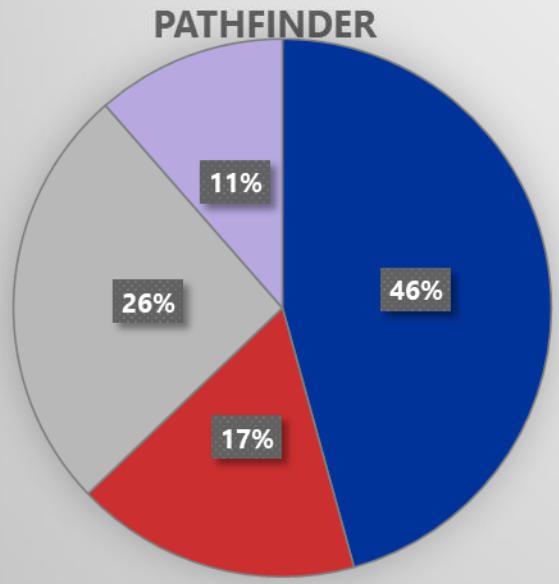
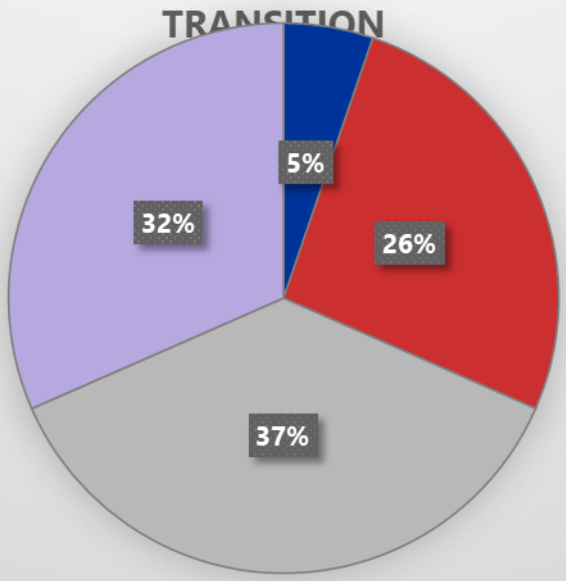
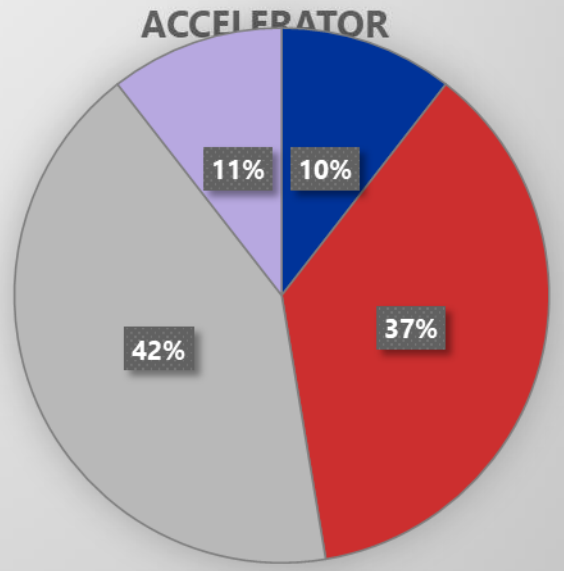


- **Nothing on power devices!**
- Many opportunities for Optoelectronics/Photonics and Sensors/Actuators
- Many Pathfinder tackle Computing/Memory/Logic but not many reach the end







Categories by Sectors/Segments/…

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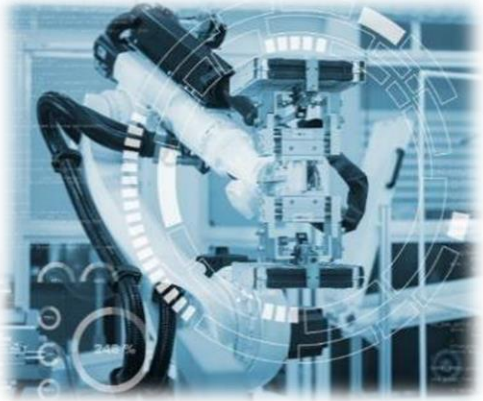
- Mobility: automotive, aerospace, etc.

- Industry and Manufacturing: machine, robots, etc..

- Consumer goods: entertainment, displays, sports, etc..



- Health and others (might be part of other portfolios: Energy, MedTech or Space)

MATERIALS/FOUNDRIES

Clustering of Applications/Sectors

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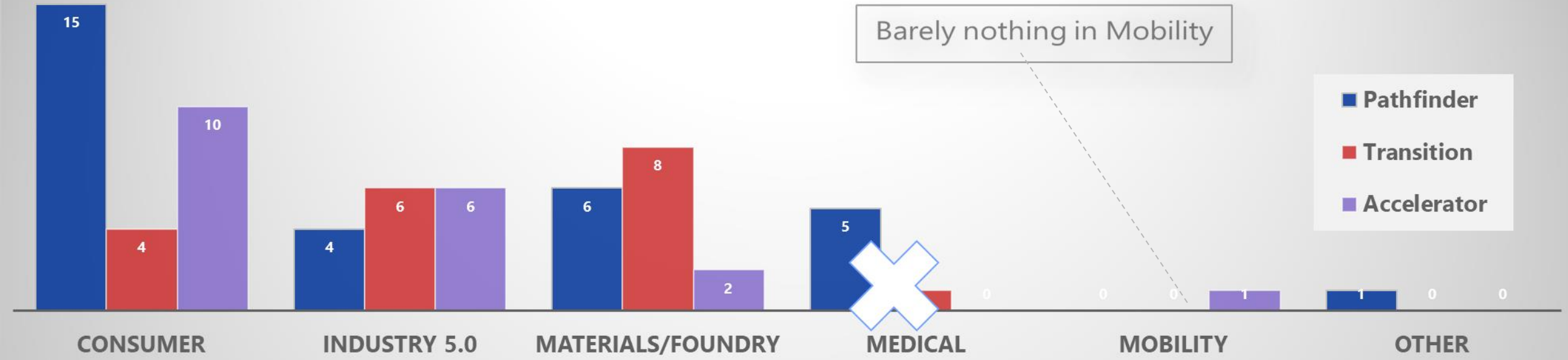

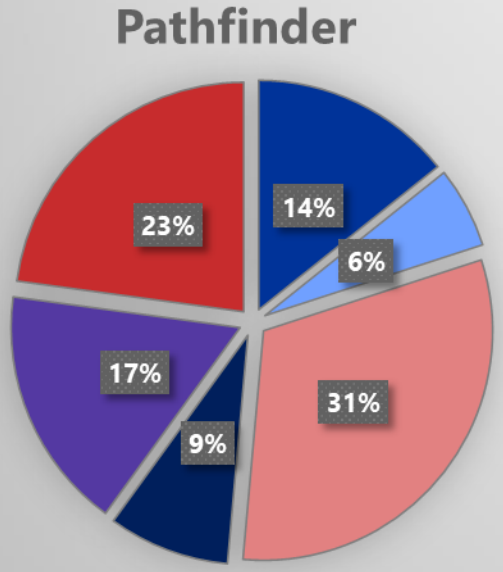

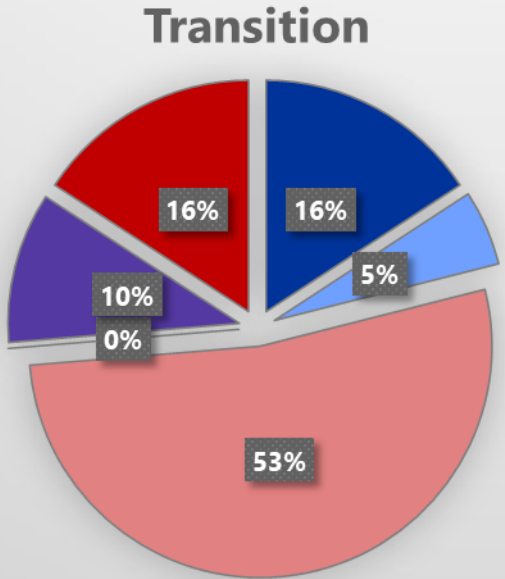

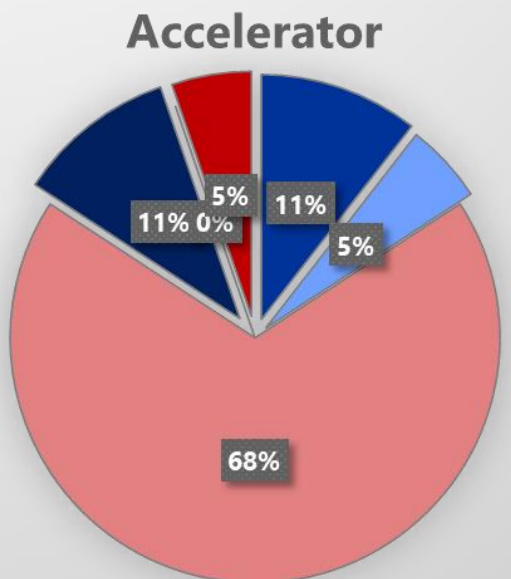

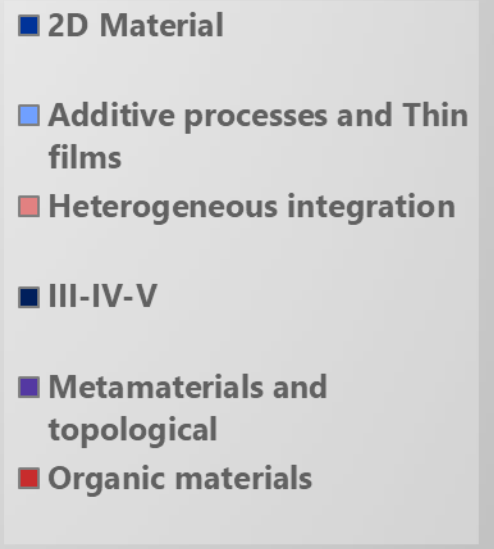

Examples of Pathfinder project in Materials for Environmental Sustainability

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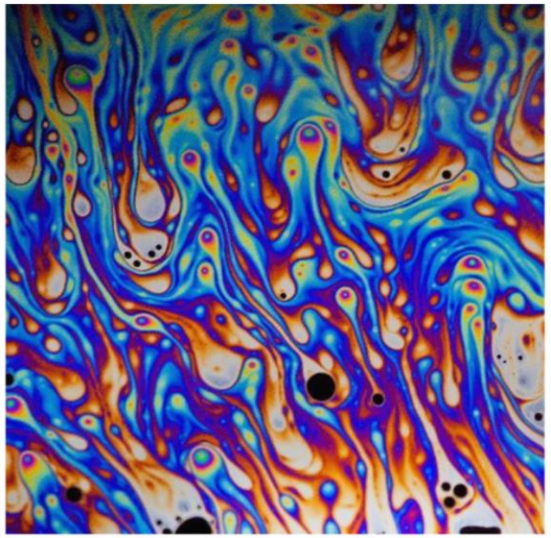
Protein-Based Next-Generation Electronics

Our ambitious EIC PathFinder project aims to realize breakthroughs with cable bacteria and their highly-conductive proteins for next-generation bio-electronics applications.

PRiNGLE is a four-year international project to design a new class of protein materials with tuned electronic properties, investigate and develop integration of these materials into electronics.



Our Offered Solution through Responsible Research and Innovation:

Within a century of fascinating progress in electronics, viable proton-based devices are yet to be developed, although nature has given us efficient and intrinsically sustainable biological systems that are fundamentally protonic.

Taking a cue from recent advances in organic electronic and protonic devices, we target a radical, foundational and sustainable breakthrough in device & sensor innovation, using designer soap films.

PROGENY

Examples of EIC project in Integrated Photonics

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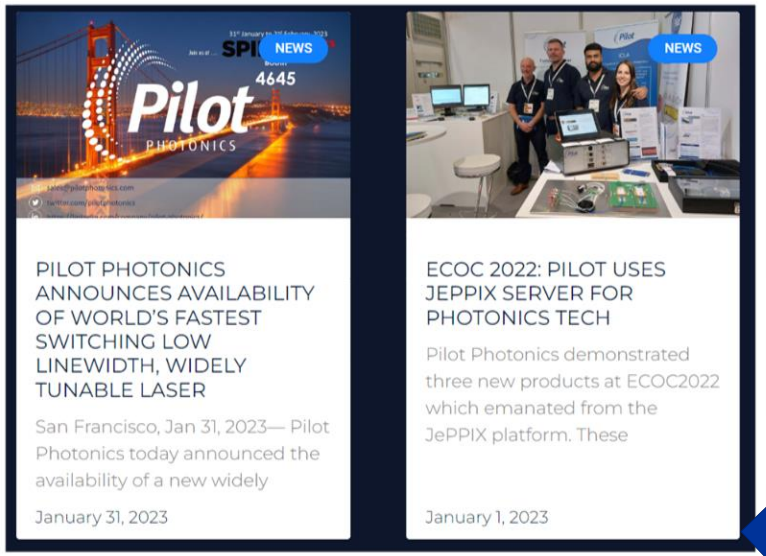
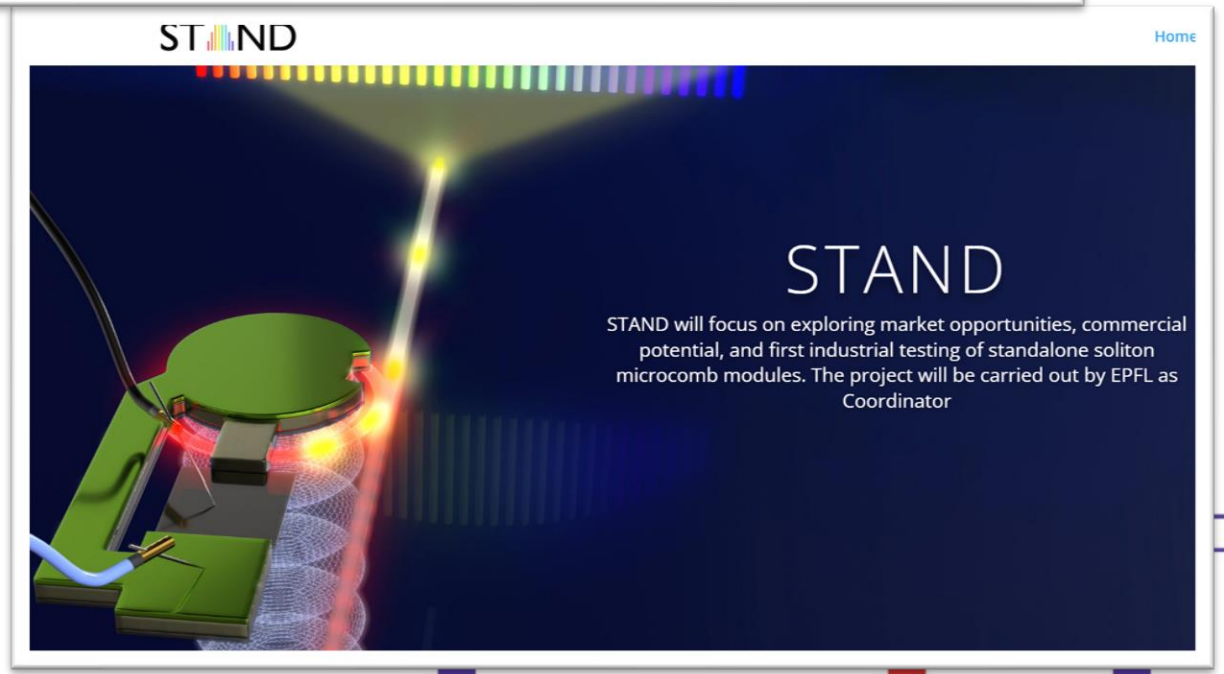
Pilot Photonics

Enabling single-chip photonic integrated circuits with comb-enhanced capabilities at wafer scale, today.



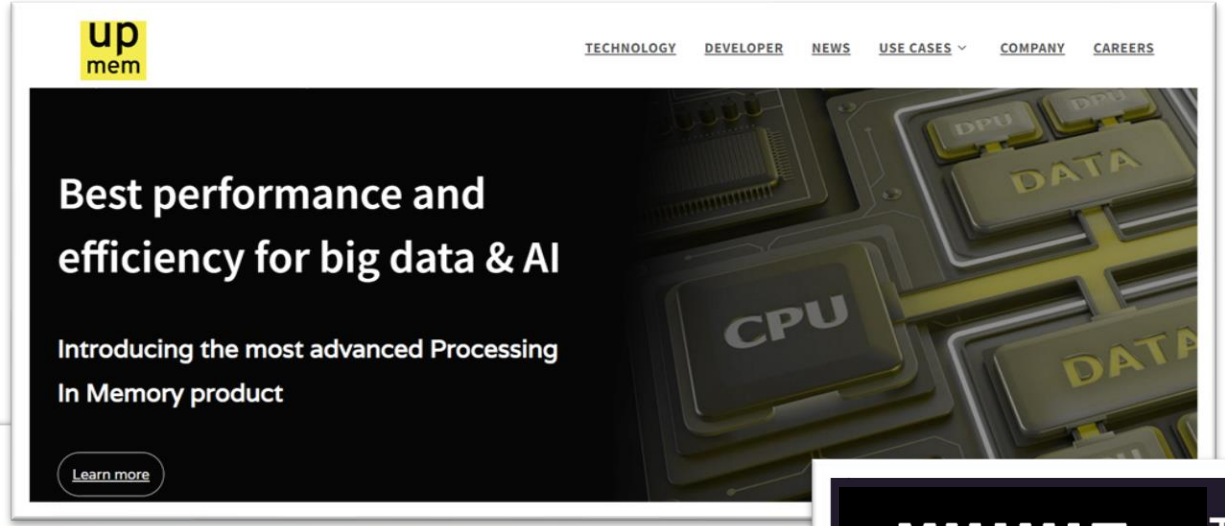
Accelerator project

Transition Project



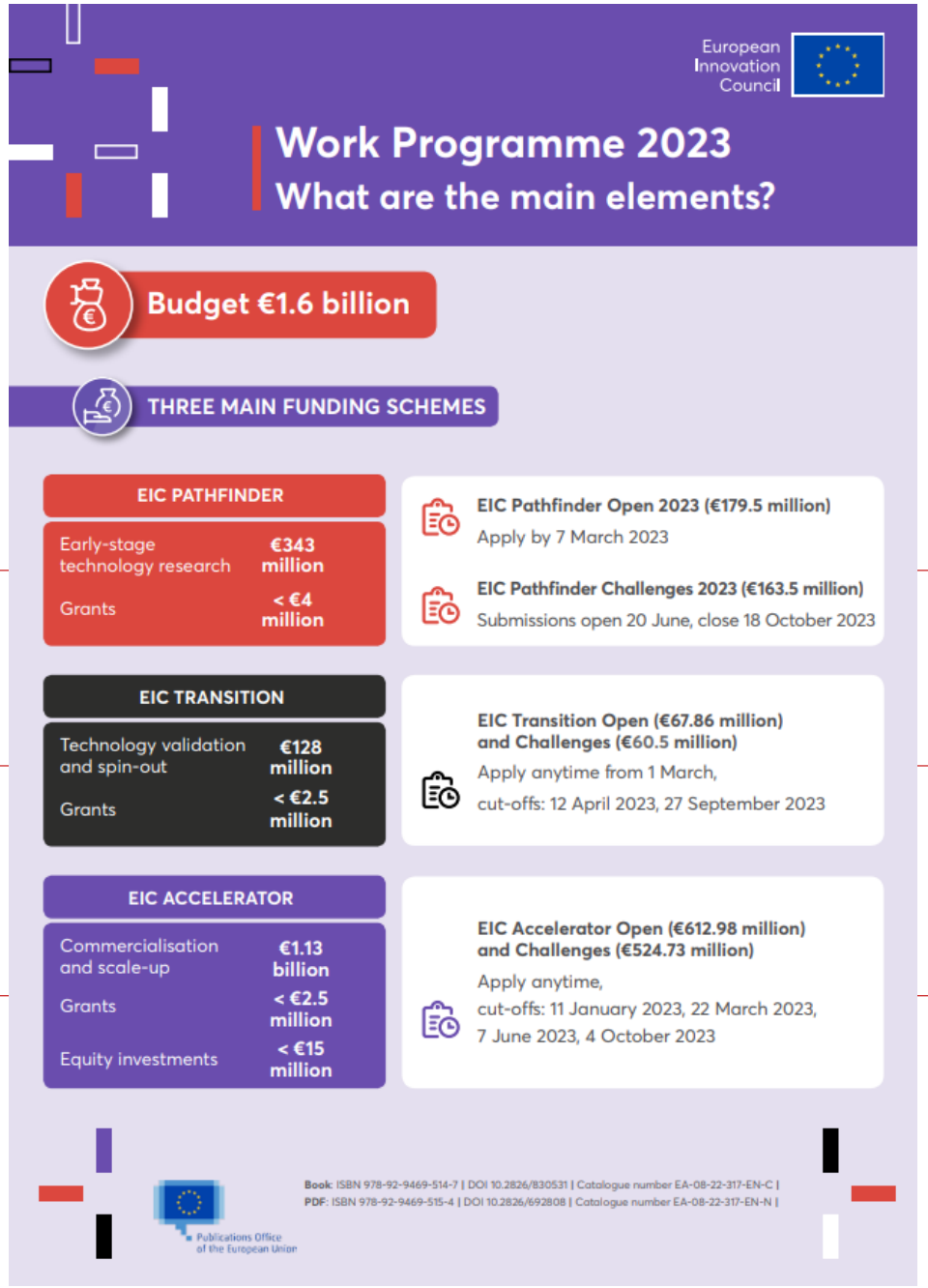
Examples of EIC Accelerator Projects

European Innovation Council



EIC Digital Challenges

EIC WP2023
Digital Challenges



TRL1-4

Open: for consortia
Challenge: single, consortia
Science and research

TRL4-6

For consortia
For single entities
EIC Pathfinder, ERC PoC
Business readiness

TRL6-9

For individual SME / start-ups
Innovation scale-up
Blended finance

Cut-off dates of the various calls

Cut-off dates:	Pathfinder	Transition	Accelerator
Open	7 March 2023	12 April 2023 27 September 2023	11 January 2023 22 March 2023 7 June 2023 4 October 2023
Challenge	18 October 2023	12 April 2023 27 September 2023	22 March 2023 7 June 2023 4 October 2023

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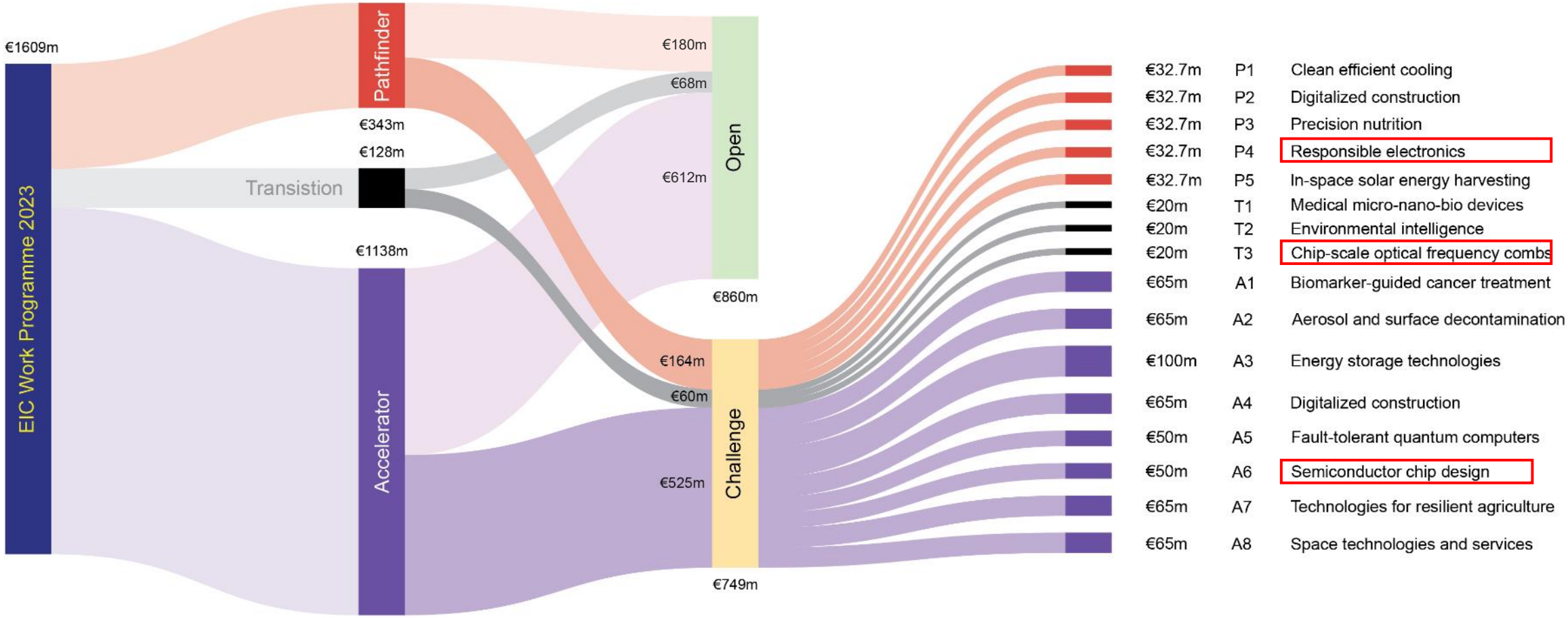
In 2023 EIC allocates ~€1.6bn to Open and Challenge calls by its Pathfinder, Transition, Accelerator programs



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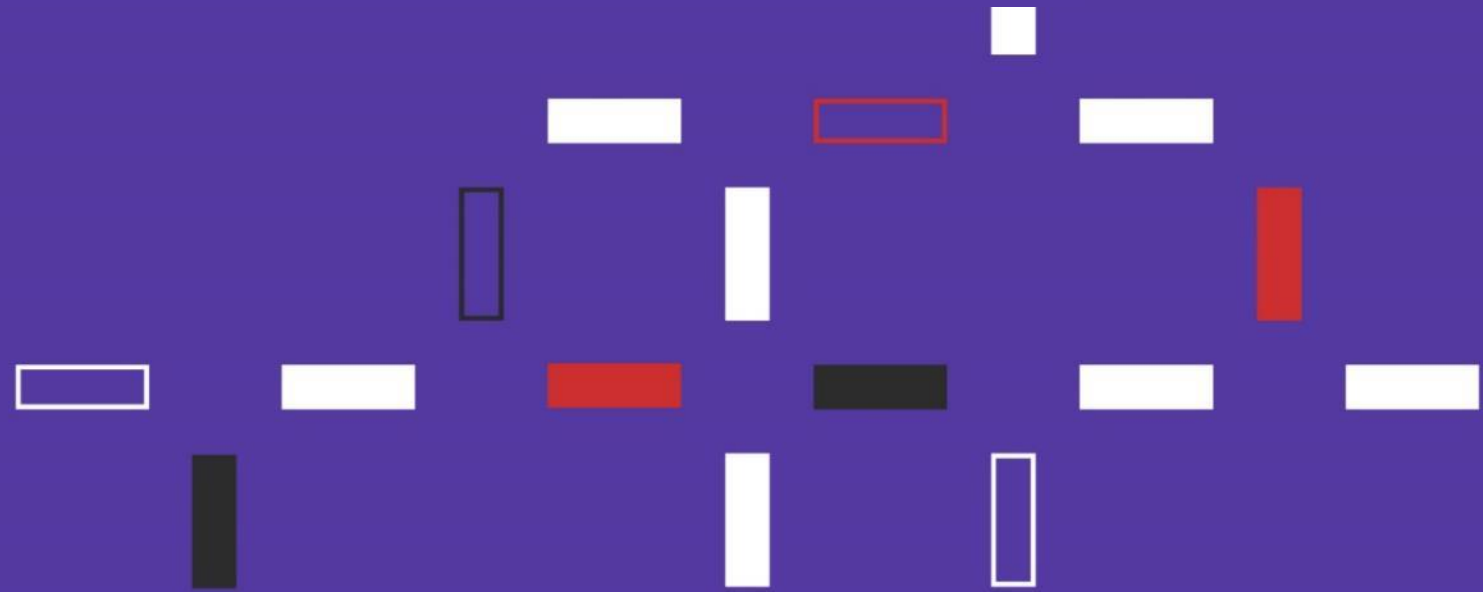
EIC Accelerator Challenge ‘Emerging Semiconductor or Quantum Technology Components’

PM: Samira Nik



Challenge Overview

This Challenge contributes to the objectives of the **Chips Act** by supporting the development of critical technologies where start-ups and SMEs with disruptive innovations have the potential to scale up and help ensure the future open strategic autonomy of the Union.

Picture from EE Times Europe

Specific conditions

- Applications to this EIC Accelerator Challenge may request an investment component of above EUR 15 million in duly justified cases.
- Technologies of a strategic nature for open autonomy should **not directly or indirectly be controlled by third countries not associated to Horizon Europe or by legal entities of non-associated third countries**.
- **Any technology under this Challenge must be developed in a robust manner, paying specific attention to safety, security and ethics considerations in future applications**.

Indicative budget

- **EUR 100.0 million**
- At least 30% of this budget will be allocated to the Quantum Technology Components and at least 30% to the Semiconductor Chip Development areas.
- The remaining will be flexibly allocated to either area in function of the successful submissions

This Challenge aims to

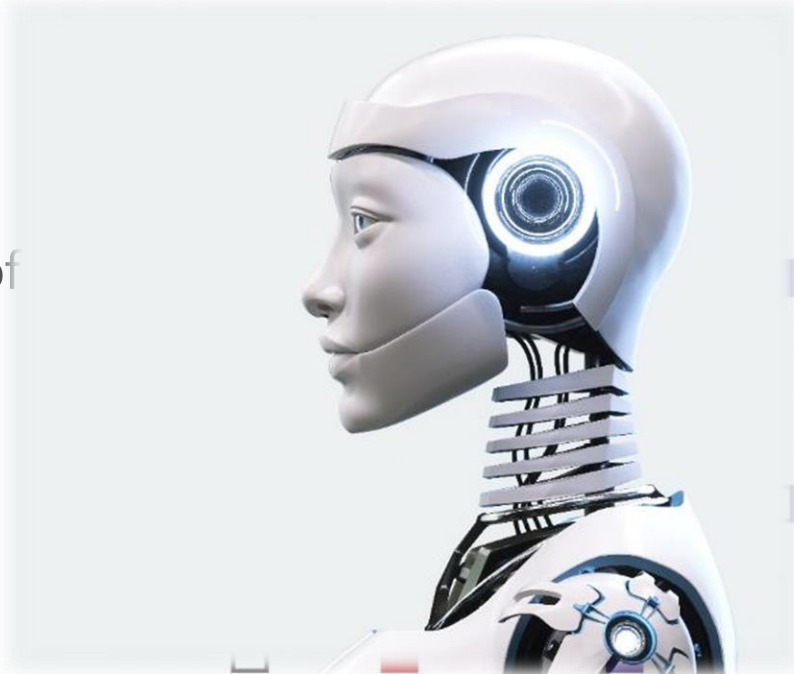
- Support the **expansion of design capabilities** and **the growth of fabless start-ups and SMEs in Europe** is of critical importance for the competitiveness, resilience and sovereignty of the Union.

- **Promote Europe's chip design ecosystem**, which could be **a cost-efficient way to climb the semiconductor value chain**, diversify EU economy and earn a strong position at the technological frontier

Specific Objectives

- The aim of this Challenge is to support the **design and development of innovative semiconductor components and intellectual property for analogue and digital integrated circuits and systems including:**
  - Memory
  - Logic
  - Optical components
  - Sensors

Application areas: Artificial Intelligence, edge computing, Internet of Things, electric and autonomous vehicles, 5G/6G communication, cybersecurity, health and wellness, environmental sustainability



Specific Objectives

- The scope also includes **innovative design approaches** that address combination of different functionalities such as **computing, RF, power, memory** and **sensing**.
- Proposals on **Software Development** for semiconductor chip design will also be considered in this challenge
- The proposing entities should demonstrate ground-breaking innovation in the respective applications fields and high potential for commercial deployment in important EU industry sectors such **as automotive, industry automation, information and communication, healthcare, aerospace, security and energy.**

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Expected outcomes and impacts

- In the mid to long term, this Challenge is expected to foster
  - the development of the semiconductor chip design ecosystem in Europe by **increasing the number of innovative fabless start-ups** and **semiconductor IP companies in the EU**,
  - **2030 Digital Compass** target of doubling EU's production of **advanced sustainable chips and Europe's digital autonomy**

EIC Transition
Chip-scale optical frequency comb

PM: Isabel Obieta

Deadline: September 27th

WP2023 Transition Challenge: Chip-scale optical frequency comb

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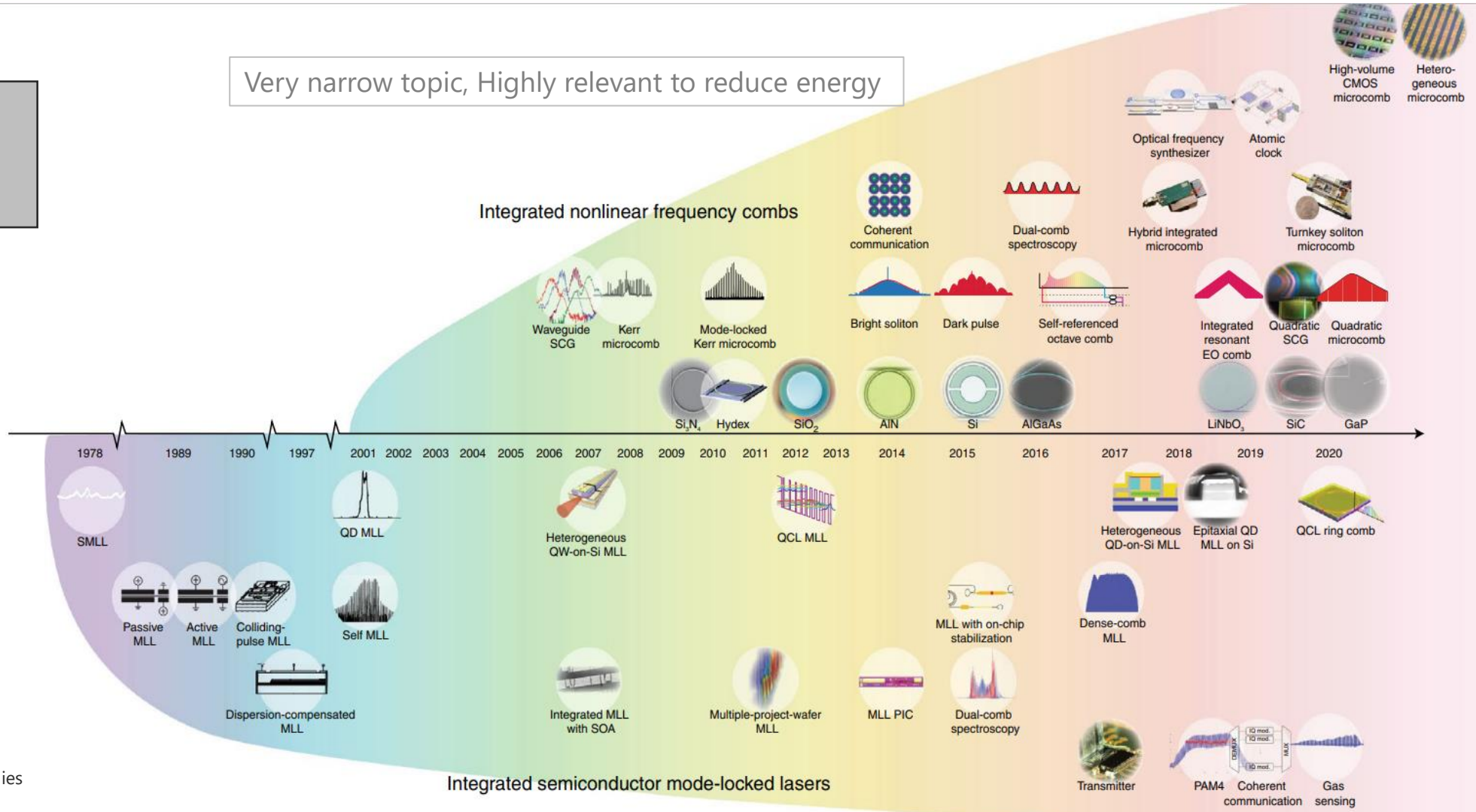
In the first cut-off, 12 proposals have been submitted

Very narrow topic, Highly relevant to reduce energy



Integrated optical frequency comb technologies
Nature Photonics Review 2022
Nature Photonics | VOL 16 | February 2022 | 95–108

Basic challenges remain to achieve the full potential of this technology

Chip-scale optical frequency combs
Overall goal and Specific objectives

European Innovation Council

The overall goal of this Challenge is to **advance technological developments of the light states in driven nonlinear systems and to develop novel platforms for chip-scale frequency combs**

The s**pecific objectives of this Challenge** aim at supporting successful transition from experimental proof of concept or technology validated in lab to technology validated or demonstrated in relevant environment by:

- Advancing or maturing novel technologies for chip-scale frequency combs for applications that require multiple frequencies of coherent laser light, with higher than the currently mainstream conversion efficiencies and with extensions to wavelength ranges, across all spectral regions with integrated photonic technologies.
- Mature the frequency combs technologies to include integration options for other functional elements, compatible with wafer scale manufacturing. Use of new nonlinear materials such as Gallium Phosphide, Lithium Niobate and others may be considered as well.
- Exploit the precision of optical frequency combs by developing concepts for new industrial applications such as:

- **Integrated multi-channel light sources for optical communication in datacentres,**
- **Highly efficient sensors that measure mid-infrared molecular spectra,**
- **Optical atomic clocks on a chip.**

The applicants should identify what are the limits of the current paradigms they are trying to improve and propose relevant metrics or KPIs to track progress and demonstrate success or a superior paradigm compared with current state of the art.

Chip-scale optical frequency combs
Expected Outcomes and Impacts

- to foster skills, talent, and innovation in semiconductor technologies, specifically for using advanced materials and the integration of photonics and microelectronics in cutting-edge chips.
- novel results deep-tech innovations for next-generation chip technologies that will enable new applications, providing strong competitive advantage for future innovative start-ups and SMEs that the EIC can further support towards scale up through its Accelerator scheme.
- An exploitation strategy (including the formal IP protection) and a credible business model, its initial validation and a business plan with the goal of attracting private investors and industrial partners.

EIC Pathfinder
Responsible Electronics

PM: Isabel Obieta

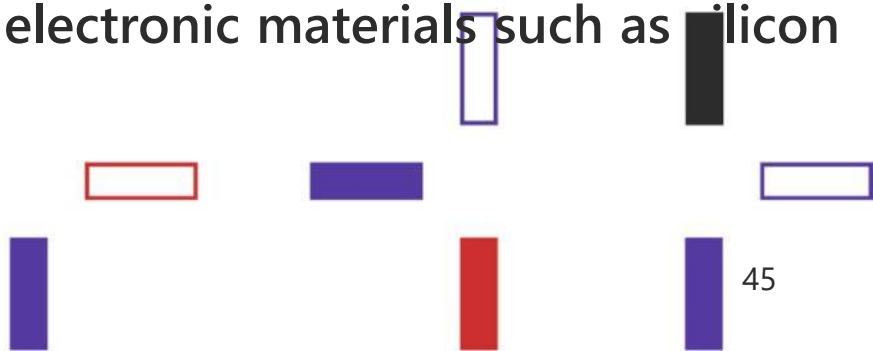
Deadline: October18th

Responsible Electronics

European Innovation Council

Overall goal and specific objectives

- **The overall goal of this Challenge is to create opportunities for discovery of new environmentally friendly electronic materials, thus reducing its environmental impact and the need for critical raw materials and hazardous chemicals .**
- **Projects supported under this Challenge are expected to offer:**
  - **materials with improved properties (such as flexibility, durability, end of life recyclability/reusability),**
  - **materials processed with low energy consumption and low carbon footprint processing (such as printing instead of photolithography, avoiding use of fluorinated gases for patterning),**
  - **or alternatives, including nano-sized ones, to replace common electronic materials such as silicon and silicon nitride.**



Responsible Electronics

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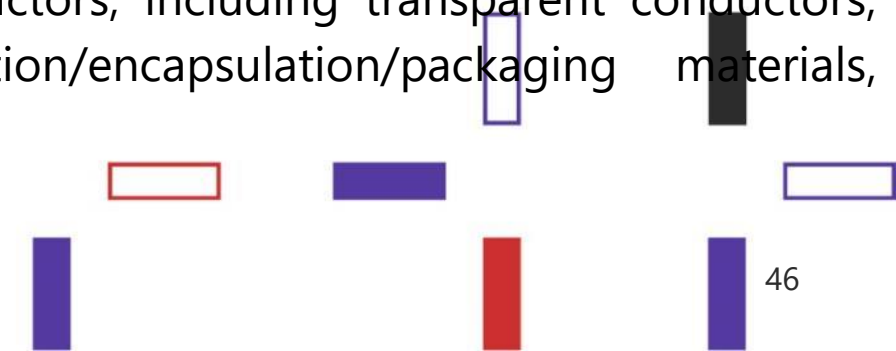
The **specific objectives** of this Challenge are to support the scientific community in reaching breakthroughs in development/discovery of:

- ✦ Advanced electronic materials for unconventional devices :
- small-molecule and polymeric organic materials,
- solution-processable inorganic materials,
- hybrid organic-inorganic materials,
- polymer-matrix nano-composite materials,
- bio-based and nature-inspired materials
- for the manufacturing of n- and p-semiconductors, dielectrics, conductors, including transparent conductors, particularly those suitable to make functional inks, passivation/encapsulation/packaging materials, flexible/stretchable substrates, etc.



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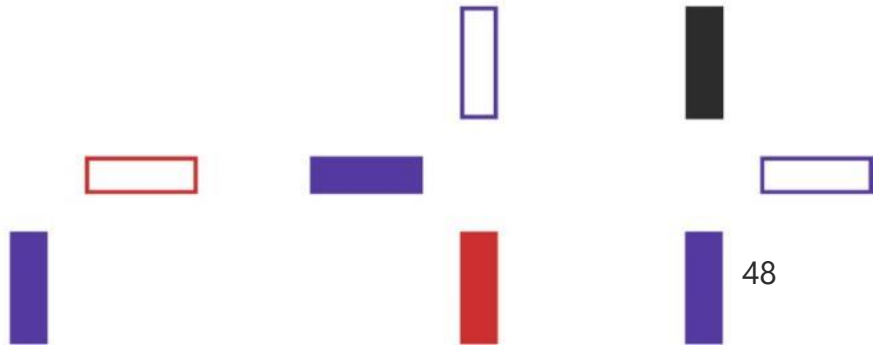
Expected outcomes and impacts

- This Challenge is expected to contribute to the development of materials with new properties or replacing materials used in current electronic devices with materials, which:

✦ reduce dependency on critical raw materials,

✦ are sustainable: having a low environmental footprint and developed recurring to the life cycle thinking approach.

- The overall outcome of this Challenge is to support the move from traditional materials and manufacturing processes to less environmental impactful ones. It is expected that the Challenge will lead to the development of **lab-scale validated proof of concept devices based on the developed innovative materials and manufacturing processes**, which may represent a potential application of a more sustainable, trusted and secure electronics.



Portfolio considerations: Categories

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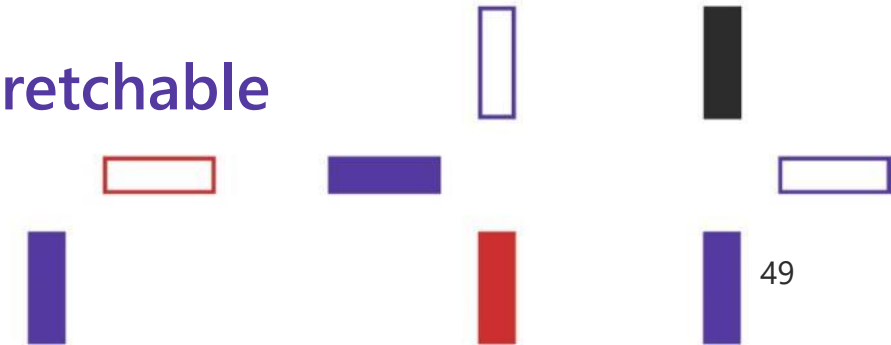
1. Organic small molecule and/or polymeric materials

2. Solution or vapor processable inorganic materials

3. Hybrid organic-inorganic materials and/or nanocomposites

4. Nature inspired solutions

5. Other radically new materials or processes for Electronic Devices particularly those suitable for functional inks, passivation/encapsulation/packaging and/or flexible/stretchable substrates



Shared components in Devices and in Technological Approach

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Devices

- Novel discrete analog components especially those for power devices
- Optoelectronic devices
- Sensors and Actuators (with at least the following sub-categories: chemical, mechanical, temperature, physiological and biosensing)
- Displays and illumination solutions
- Logic circuits, microprocessors and memories
- Wireless transmitters/receivers and other devices for Communication
- ..

Technological approach

- Printing techniques for flexible devices: Inkjet, aerosoljet, etc..
- Solution-based coating techniques: slot-die, spray-coating, blade-coating dip-coating, etc..
- 3D printing
- Vapor or other energy-efficient source based processes
- Low-energy low-carbon emission patterning: adhesion lithography
- …

Portfolio considerations: Categories and shared components

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To maximise the overall impact on the expected outcomes and impacts of the Challenge:

Shared components:

- a device (sensors, power components, etc...)

- and/or technological approach or process (such as but not limited to additive techniques, plasma based or others)

Category	Shared component/complementarity	
	Devices	**Technological approach**
i) Organic small molecule and/or polymeric materials **ii)** Solution or vapor processable inorganic materials **iii)** Hybrid organic-inorganic materials and/or nanocomposites **iv)** Nature inspired solutions **v)** Other radically new materials or processes for Electronic Devices particularly those suitable for functional inks, passivation/encapsulation/packaging and/or flexible/stretchable substrates	• Novel discrete analog components especially those for power devices • Optoelectronic devices • Sensors and Actuators (with at least the following sub-categories: chemical, mechanical, temperature, physiological and biosensing) • Displays and illumination solutions • Logic circuits, microprocessors and memories • Wireless transmitters/receivers and other devices for Communication • ..	• Printing techniques for flexible devices: Inkjet, aerosoljet, etc.. • Solution-based coating techniques: slot-die, spray-coating, blade-coating dip-coating, etc.. • 3D printing • Vapor or other energy-efficient source based processes • Low-energy low-carbon

Challenge Strategy plan

This Challenge aims at:

- **Enhancing the opportunities of the new environmentally friendly electronic materials potential or novel processes** of the portfolio individual project: *Ensuring that portfolio members can access a much higher number of relevant applications/devices to explore key partnerships*
- **Enhancing the commercialisation potential of the portfolio individual project**: *Ensuring that portfolio members can access the right industry partners to explore key partnerships*

→ Strategy plan for the Responsible electronics portfolio

Conclusions

Conclusions

- **WP 2023 -** EIC 2023 work programme (europa.eu):
  - Check eligibility criteria for each instrument and the different deadlines
  - Recording of Info day
  - Contact your NCP (National Contact Points) to discuss your ideas

- Open calls for any ideas (bottom-up)
- Challenge calls for specific topics
  - Recordings available of the Info Days for the specific Challenges

EIC Pathfinder Challenge "Responsible Electronics" - Information Day (europa.eu)

  - Of interest for this community:

Pathfinder Challenge: RESPONSIBLE ELECTRONICS, deadline: October 18th

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Thank you!

https://eic.ec.europa.eu

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