

EPI Forum

Barcelona, 9–10.10.2024.





EuroHPC
Joint Undertaking

EuroHPC chips initiatives: the road towards European technological sovereignty

10th October 2024 | **Alexandra Kourfali** | Barcelona

Who are we?



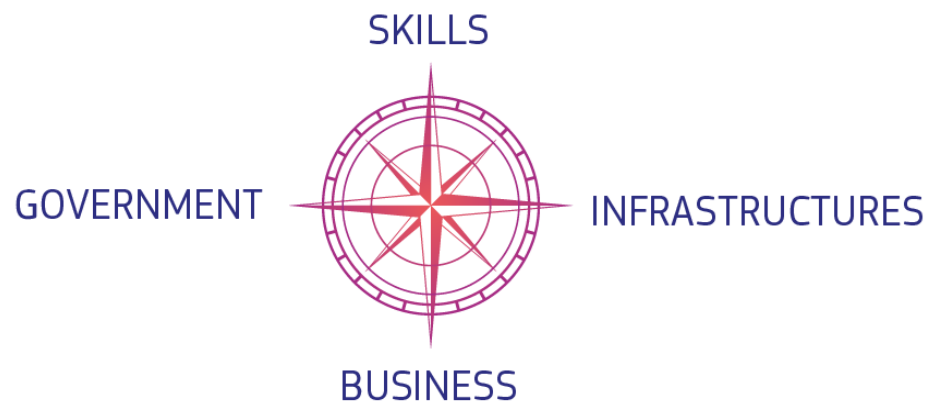
- EU body & legal and funding entity
- Created in 2018
- Autonomous since Sep. 2020
- Based in Luxembourg
- A team of 40 employees
- Still growing!

Our Mission

The European way for the Digital Decade



EuroHPC
Joint Undertaking



2030 Digital Compass



Our Mission



EuroHPC
Joint Undertaking

- Develop, deploy, extend & maintain a **world-leading supercomputing, quantum computing**, and service & data infrastructure ecosystem in Europe
- Support the development of **innovative supercomputing components, technologies, knowledge & applications** to underpin a competitive European supply chain
- Widen **the use of HPC & quantum infrastructure** to a large number of public & private users located in Europe
- Support the development of **HPC skills** for EU science & industry

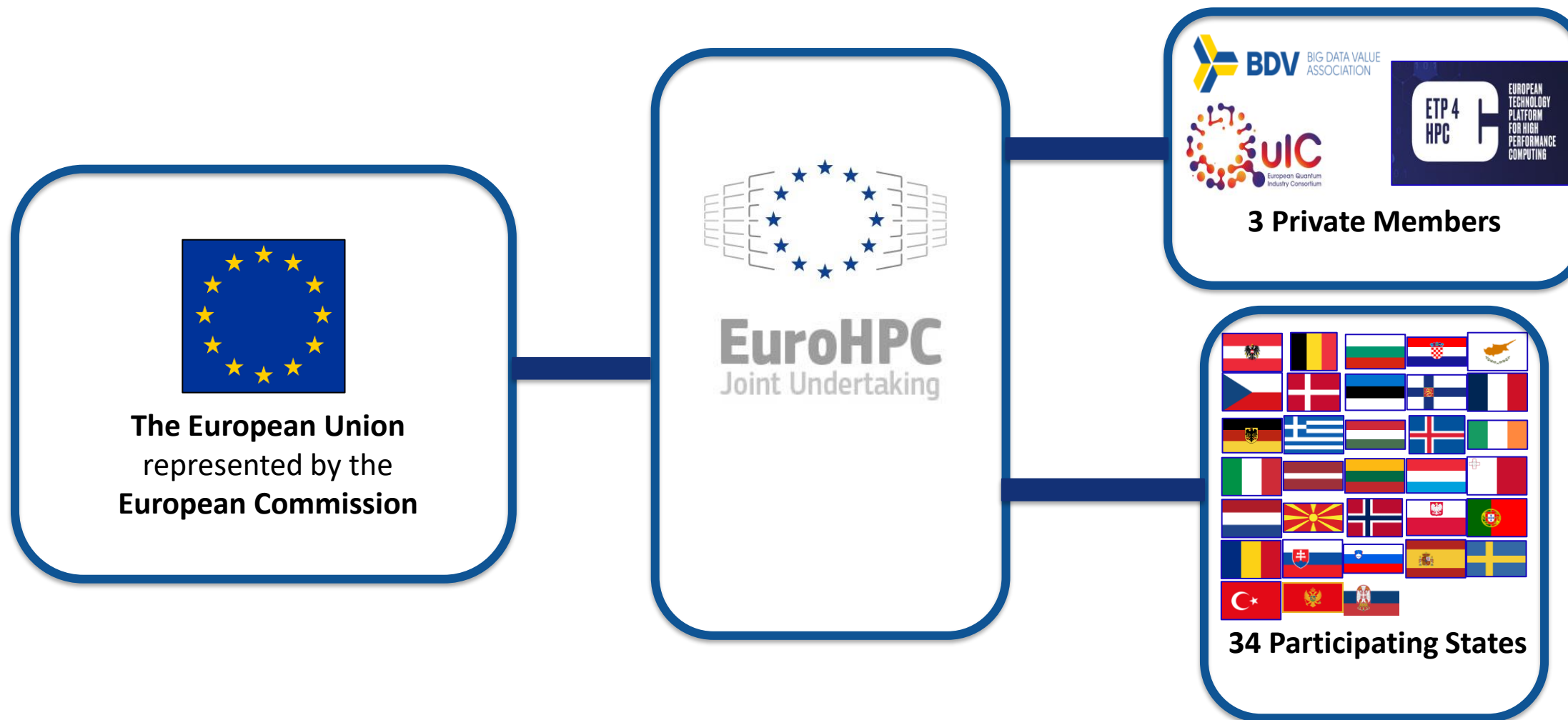


Our Organization

Co-funded by EU, Participating States and Private Members



EuroHPC
Joint Undertaking

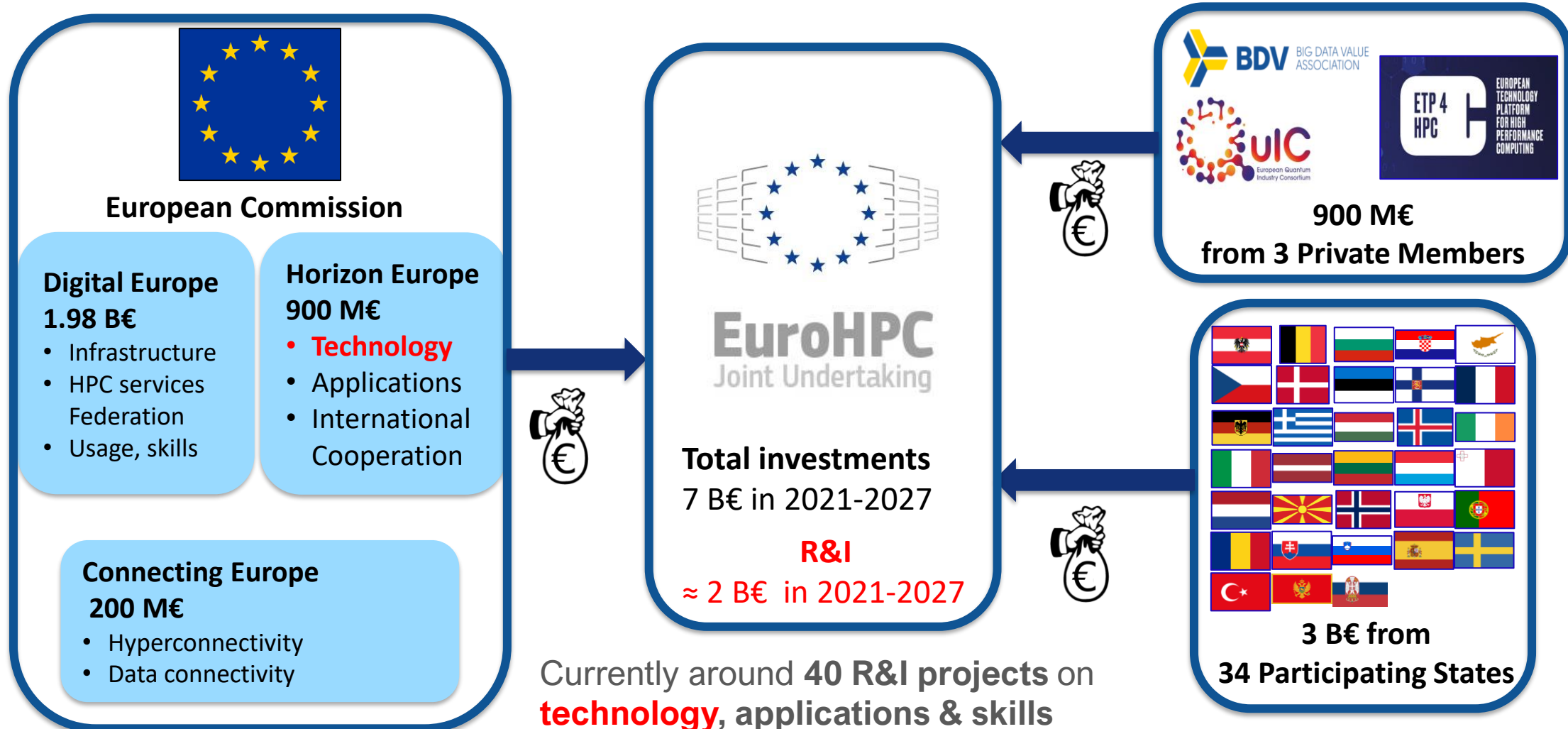


Our Organization

Co-funded by EU, Participating States and Private Members



EuroHPC
Joint Undertaking



EuroHPC



Infrastructure



EuroHPC
Joint Undertaking



PROCURED

5 PETASCALE

- Vega in Slovenia
- Karolina in Czechia
- Discoverer in Bulgaria
- Meluxina in Luxembourg
- Deucalion in Portugal

3 PRE-EXASCALE

- LUMI in Finland
- Leonardo in Italy
- MareNostrum 5 in Spain



ONGOING

1 EXASCALE

- Jupiter, the first European Exascale in Germany

2 MID-RANGE

- Arrhenius in Sweden
- Daedalus in Greece

- 8 quantum systems underway

COMING NEXT

A SECOND EXASCALE

- in France

UPGRADES

- Discoverer+
- Lisa/Leonardo

AN INDUSTRIAL SYSTEM

- Co-owned and for use by the industrial sector
- For AI and other applications

A POST-EXASCALE SYSTEM

PROCUREMENT OF FEDERATION SERVICES

- A platform for the federation of EuroHPC HPC and quantum infrastructure
- A one-stop shop access point for users

Global standing of EuroHPC SC



EuroHPC
Joint Undertaking

MAY 2024	TOP500	Green500
LUMI	#5	#12
LEONARDO	#7	#28
MARENOSTRUM 5	#8	#15
MELUXINA	#89	#39
KAROLINA	#135	#36
DEUCALION	#219	#80
DISCOVERER	#188	#280
VEGA	#226	#304
JEDI (Jupiter's first module)	#189	#1



EuroHPC
Joint Undertaking



Strategic Research & Innovation areas



EuroHPC
Joint Undertaking

EuroHPC JU funds an R&I programme to develop a full **European supercomputing ecosystem**, support European **digital autonomy**, to reduce Europe's dependency on **foreign manufacturers**

»» **Leadership in Use & Skills**

Competence Centres & training programmes in HPC commensurate with the labour market.

»» **Applications and Algorithms**

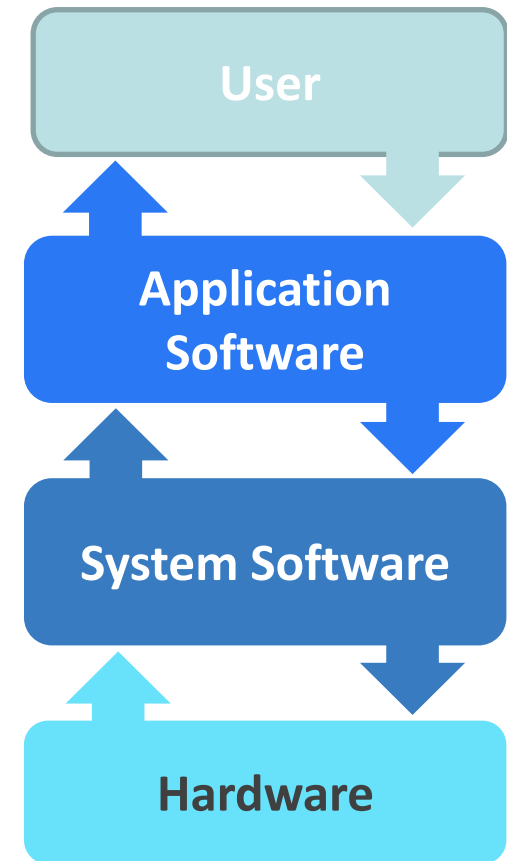
Centres of Excellence for HPC Applications & algorithms for EU exascale

»» **European Software Stack**

SW, algorithms, programming models and tools for exascale & post exascale

»» **European Hardware**

Ecosystem for low power high-end general purpose processor & accelerator



EuroHPC JU's ambition for EU Chips



EuroHPC
Joint Undertaking

Build a diverse IP/HW Portfolio

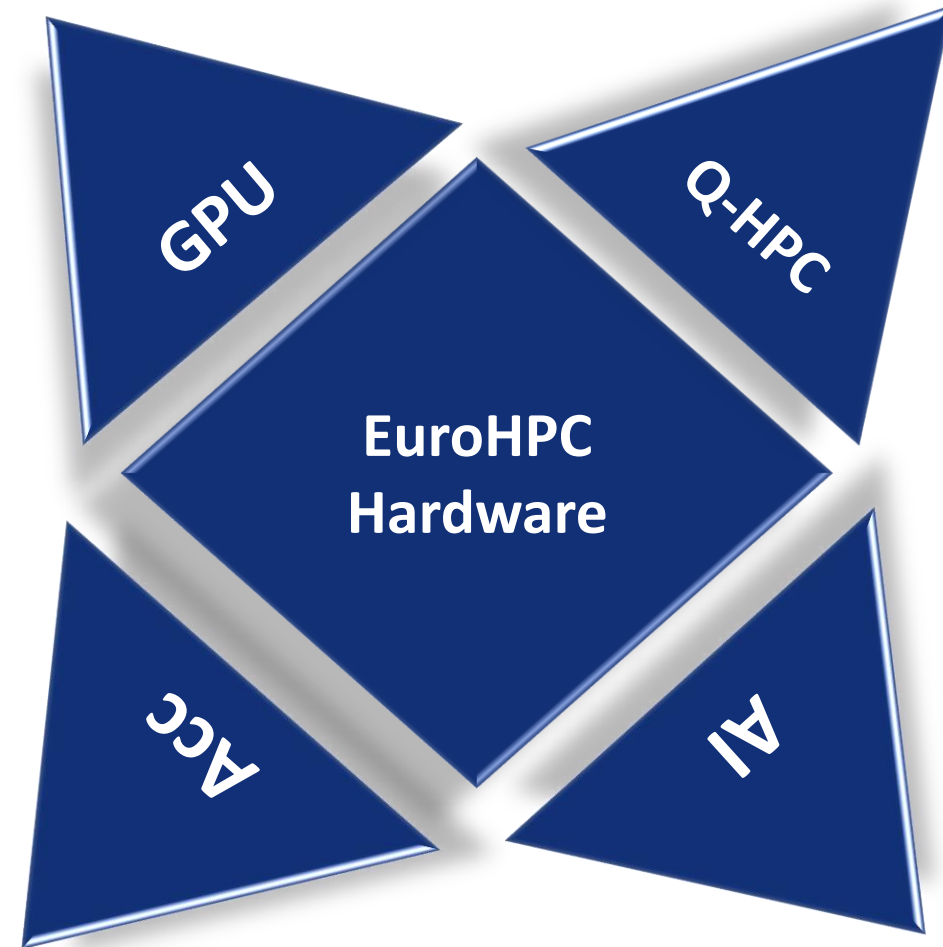
- Processors
- Accelerators
- Quantum chips
- AI accelerators

Pilots and demonstrators

- FPGAs, prototyping platforms, Pilots

Scale-to-exascale ecosystem:

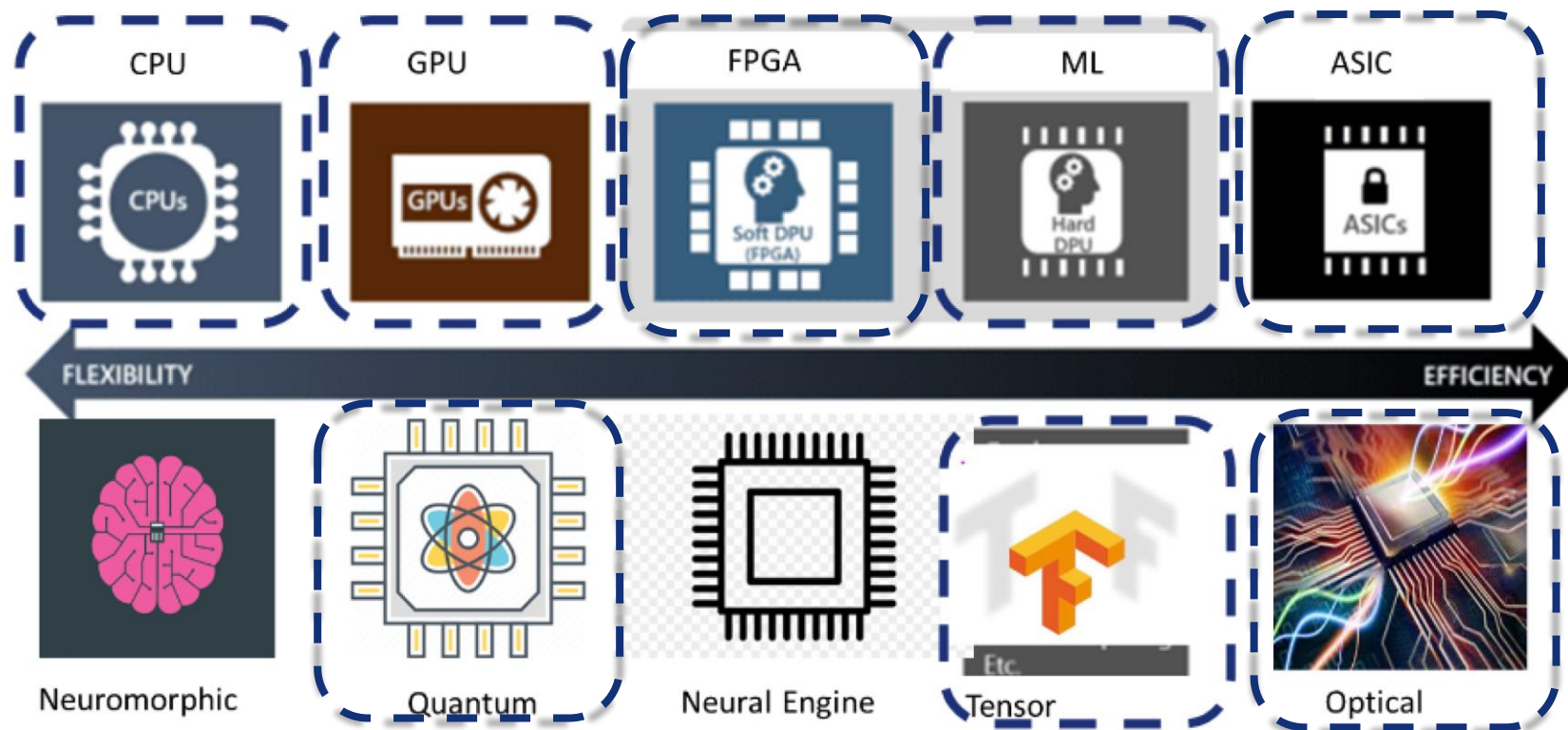
- SW stack
- Applications



Current and future Chips in EuroHPC



EuroHPC
Joint Undertaking



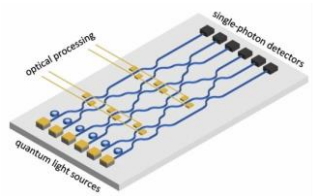
Diversity in Quantum technologies



EuroHPC
Joint Undertaking

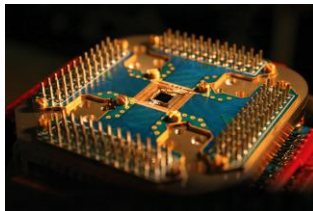
EuroQCS- France

Photonic
quantum
computer



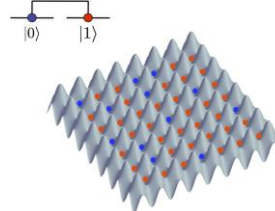
Euro-Q-Exa (Germany)

Superconducting
qubits



EuroQCS- Italy

Neutral atoms



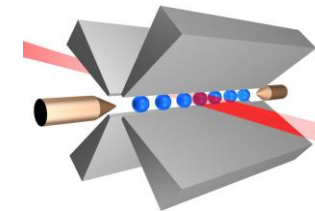
Lumi-Q (Czechia)

Superconducting
qubits with a star-
shaped topology



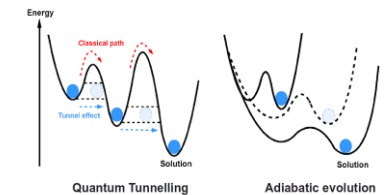
EuroQCS- Poland

Trapped ions



EuroQCS- Spain

Quantum
annealer



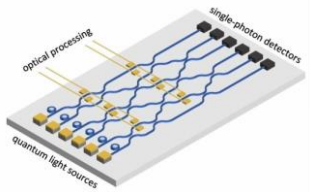
Diversity in Quantum technologies



EuroHPC
Joint Undertaking

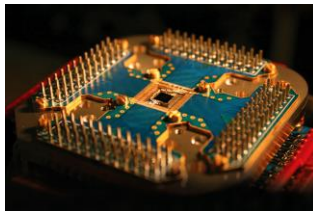
**EuroQCS-
France**

Photonic
quantum
computer



**Euro-Q-Exa
(Germany)**

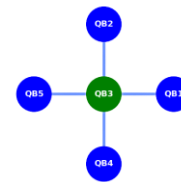
Superconducting
qubits



QPUs

**Lumi-Q
(Czechia)**

Superconducting
qubits with a star-
shaped topology



Q-sw
stack into
HPC
nodes

(HPC+QC)
platform
Cryo+qc ctrl
HW



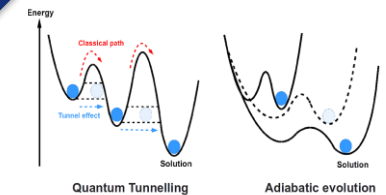
**EuroQCS-
Spain**

Quantum
annealer

Super-
conducting
circuits

analog
quantum
processor

adiabatic
quantum
compute
units

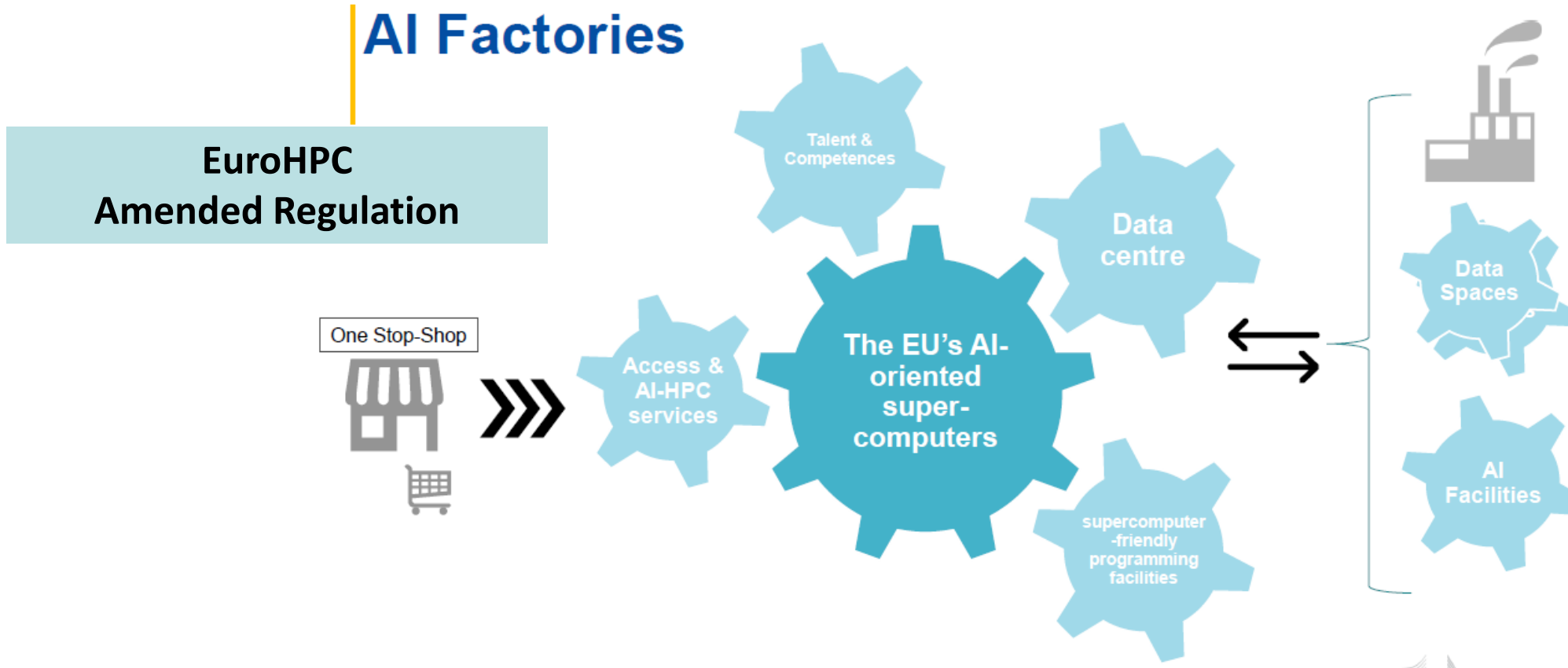


AI Initiatives at EuroHPC



EuroHPC
Joint Undertaking

AI Factories



- Background: new AI initiative announced by vd Leyen in 2023
- A new objective defined for EuroHPC JU

AI Initiatives at EuroHPC



EuroHPC
Joint Undertaking

- **AI Factories**: Making available HPC computing capacity to facilitate the development of GenAI models/ Applications
- **AI Opportunities**
 - Support Centre for HPC-powered AI Applications
 - Applications (Over 100 AI projects have been active on EuroHPC SC)
 - AI software stack (upcoming call)
 - Benchmark suite for AI-optimized HPC systems (upcoming call)
 - HPC-AI chips

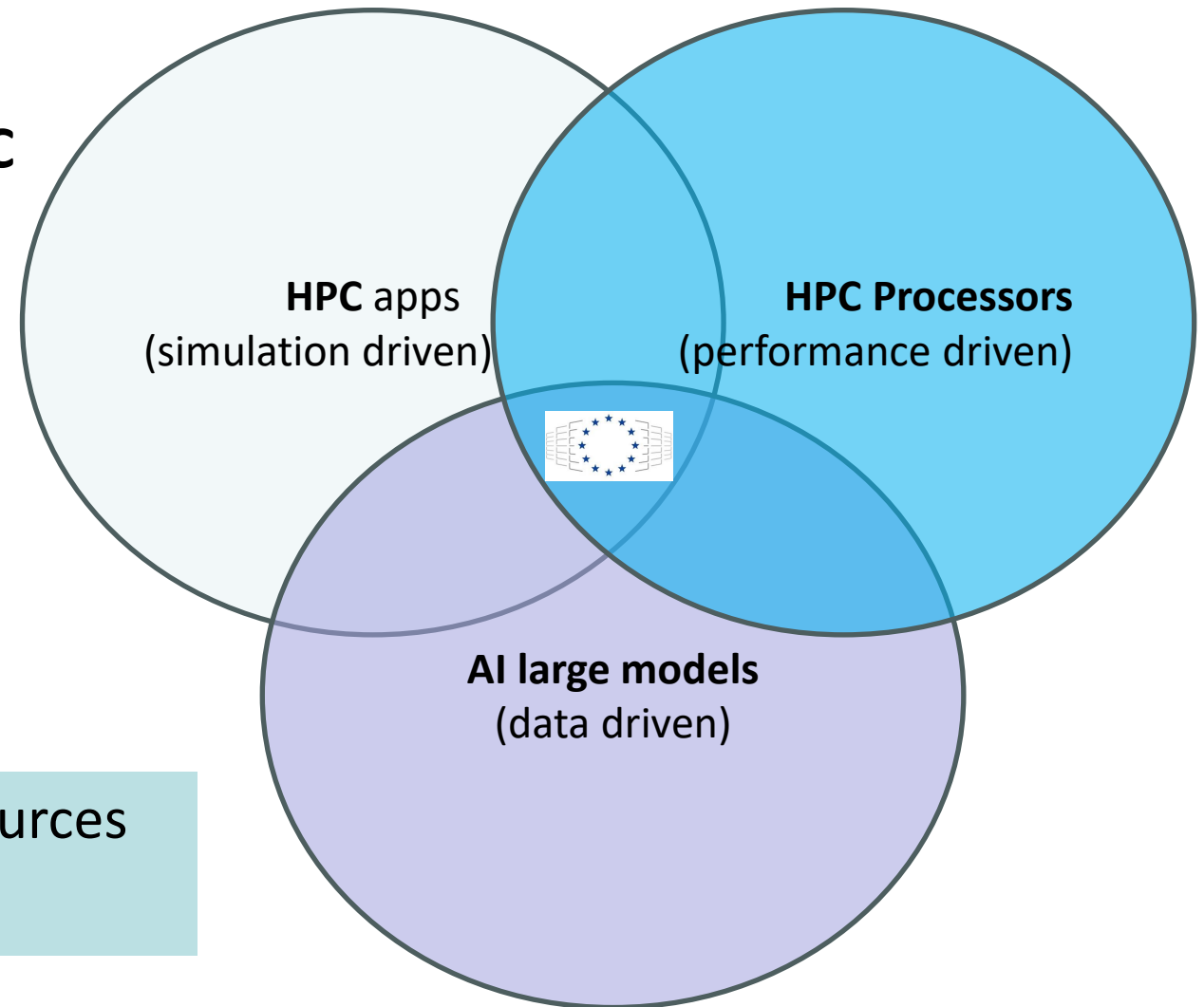
AI chips in EuroHPC



EuroHPC
Joint Undertaking

AI is an enabler and a disruptor for HPC

- AI inference
- AI-infused applications
- Mixed precision
- xPu



Large foundation models need SC resources

Join-em / beat-them / OR....

The future AI Chips in EuroHPC



EuroHPC
Joint Undertaking

AI chips in EuroHPC and the AI factories

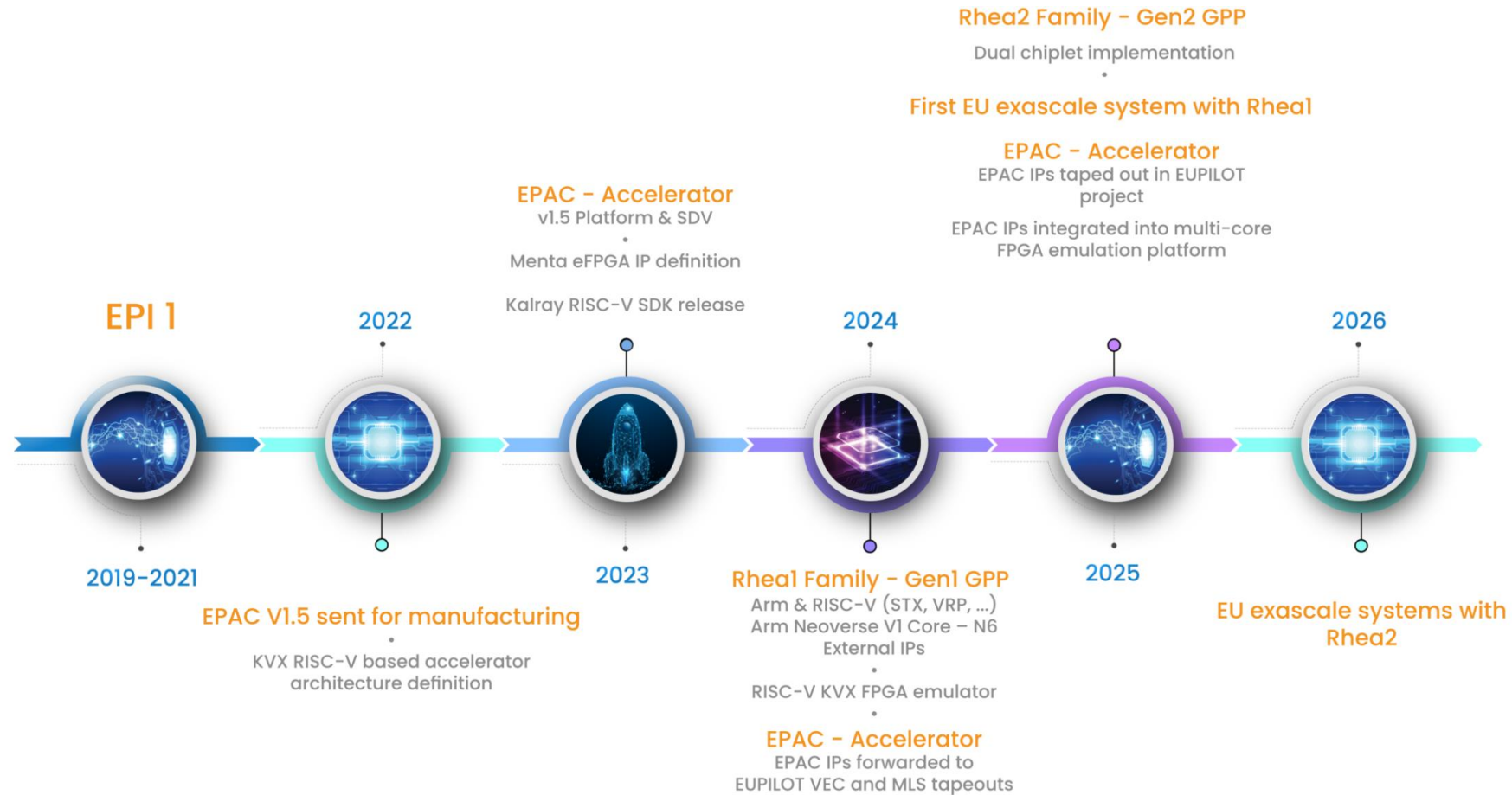
- **Future AI processors and accelerators**
 - **ARM-based**
 - » Now: RHEA1
 - » Soon: Chiplet solution
 - **RISC-V based**
 - » Now: MLS for HPDA
 - » Now: STX incl AI specific acc cores for stencil and neural network computation
 - » Soon: AI inference chiplet solution: SiP of AIPU + GPP
- **Future SW**
 - **AI SW stack and applications**

EPI-SGA2 at EuroHPC

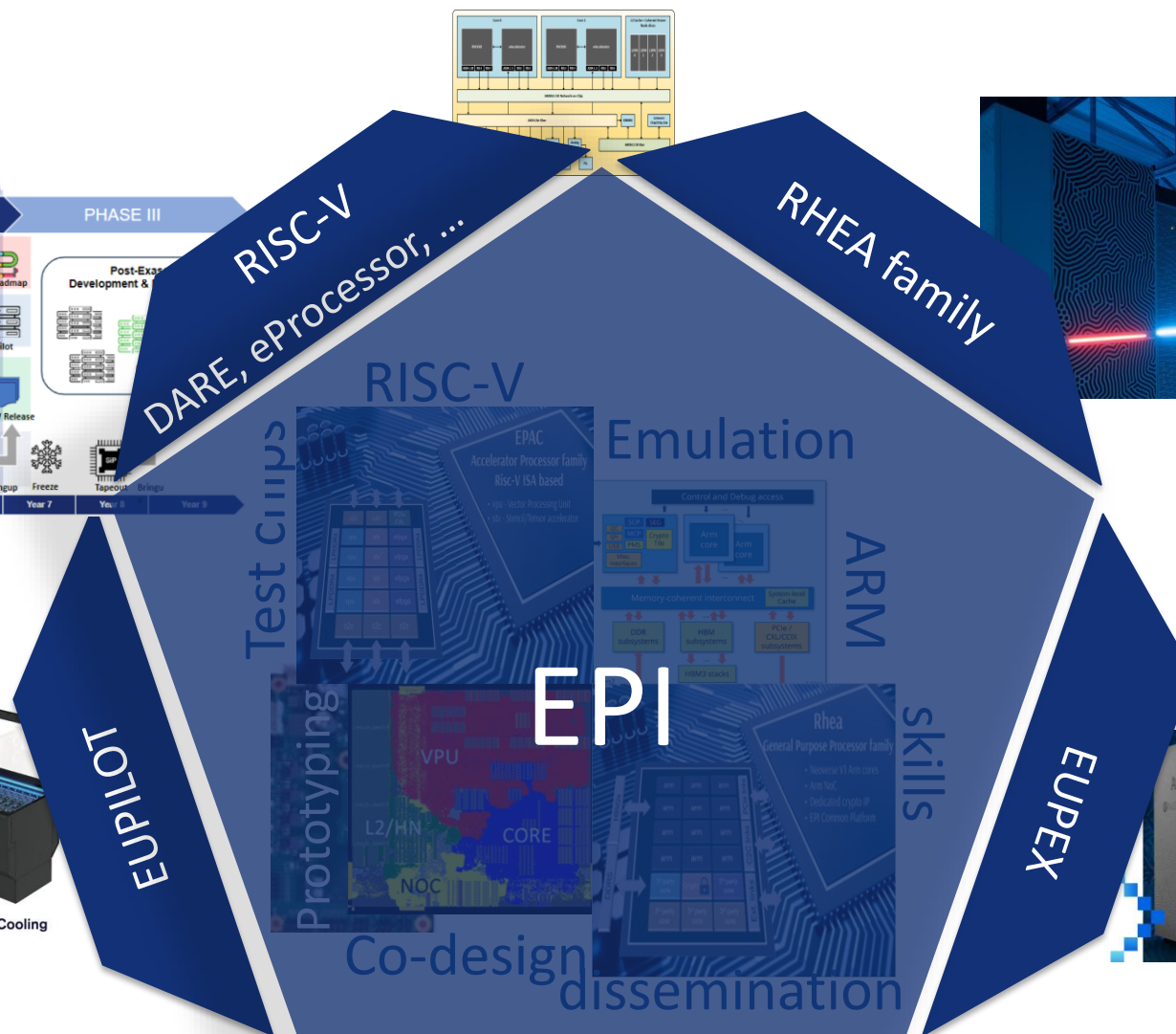
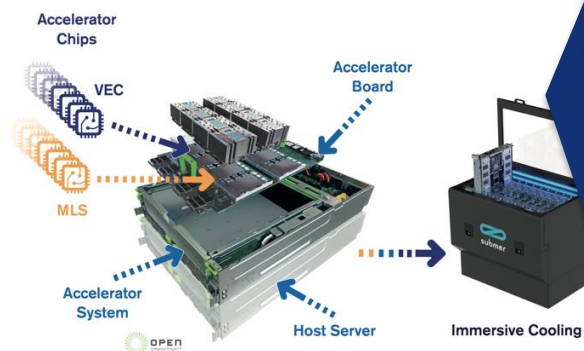


EuroHPC
Joint Undertaking

EPI umbrella and ecosystem



umbrella and ecosystem



Microprocessor Technology: Strategy

EU goal: autonomy in strategic processing technologies



EuroHPC
Joint Undertaking

Our ambition: by 2030

- *The production of cutting-edge and sustainable semiconductors in Europe including processors is at least **20% of world production** in value*
- *Manufacturing capacities below **5nm** nodes aiming at 2nm*
- ***Energy efficiency** 10X more than today*

- ✓ ***RISC-V ISA plays a central role on EU's technology strategy***
- ✓ ***AI needs are reforming EU's strategy in processors***

Microprocessor Technology: Strategy

EU goal: autonomy in strategic processing technologies



EuroHPC
Joint Undertaking

MANUFACTURING

2 nm and below technology and production facilities

DESIGN

Short term (2024-26)

First IPs

- **Build on EPI** efforts on ARM-based processor
- From test chips to **TRL 9**
- EuroHPC exascale systems as first customer and scale to **embedded**

Medium term (2026-28)

New RISC-V architectures

- **Complement the work of EPI** and Pilots on RISC-V with stand-alone competitive GPPs and GPUs
- Collective effort building on **EU R&D** in low power, security,...,
- EuroHPC **post-exascale** system as first customer

Long term (2028-)

Post-exascale RISC-V systems based on EU R&D, manufactured in EU.

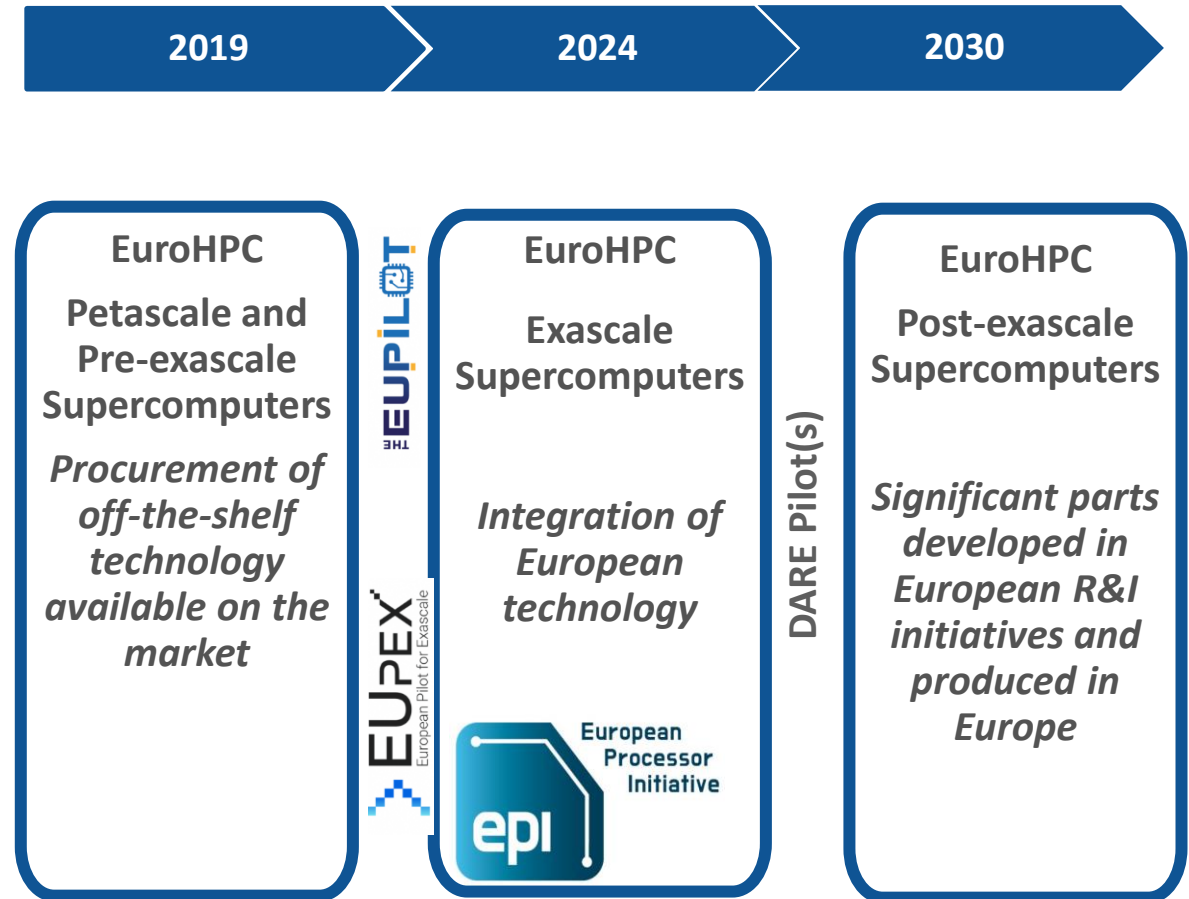
Ongoing EU activities on HPC Technology



EuroHPC
Joint Undertaking

EU goal: autonomy in strategic processing technologies

- **Strategic R&I roadmap** to design and deliver energy efficient open hardware technology
- **Framework Partnership Agreements:**
 - **EPI:** European low-power microprocessor technologies
 - **DARE:** Large-scale European initiative for High Performance Computing ecosystem based on RISC-V



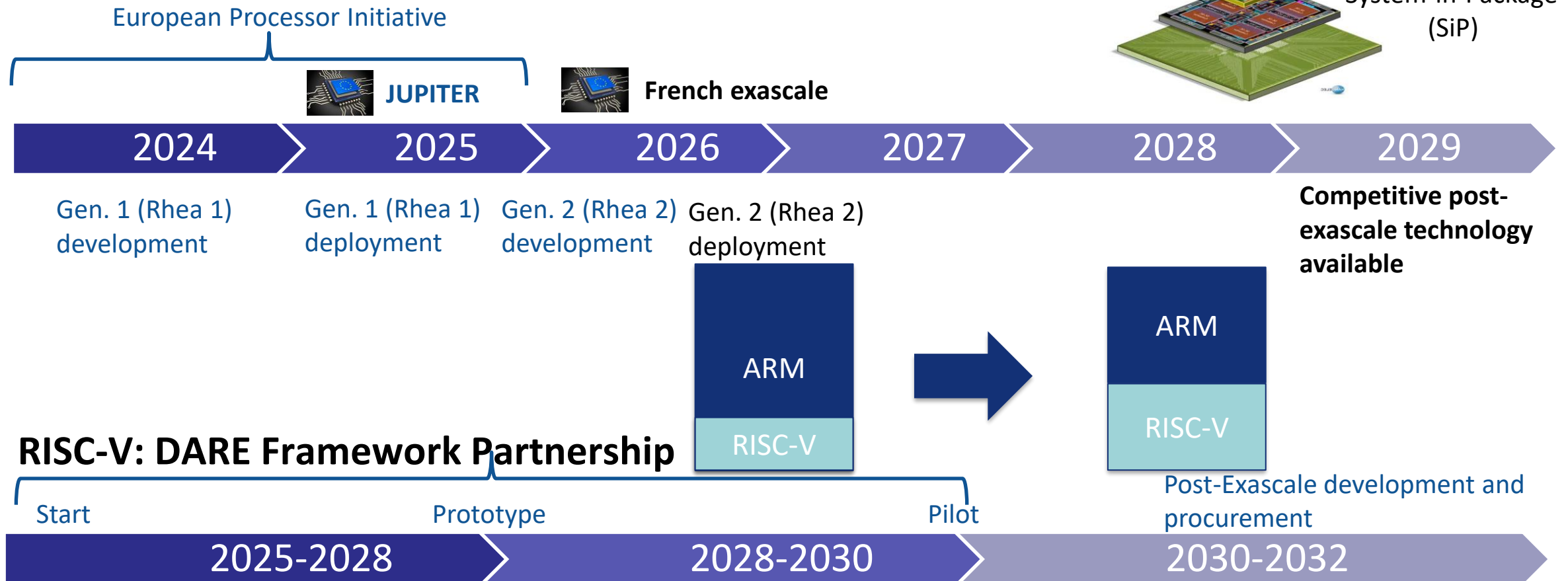
HPC microprocessor technology

Where are we now?



EuroHPC
Joint Undertaking

ARM: European low-power microprocessor technology (*Rhea*)

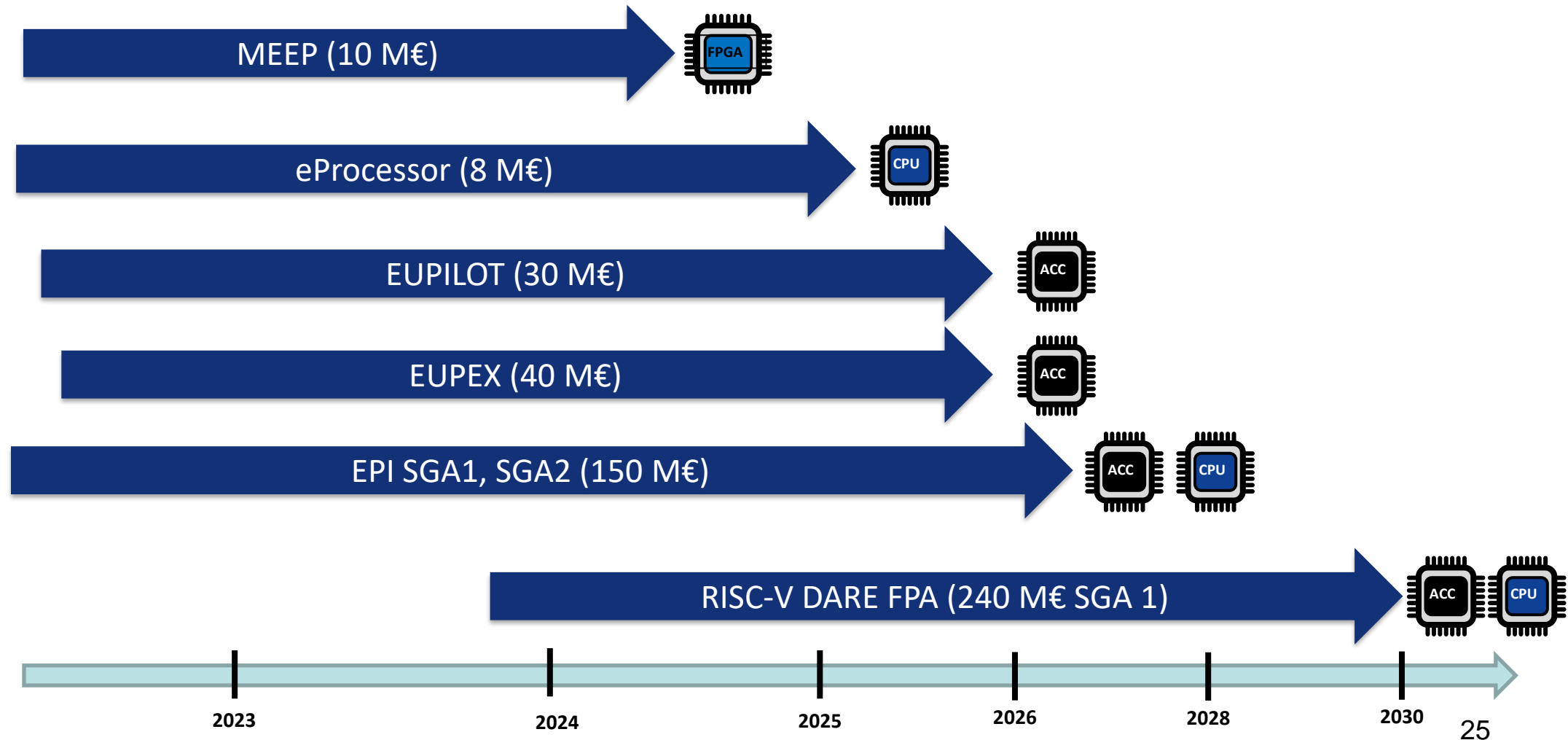


Ongoing EU activities in processor design



EuroHPC
Joint Undertaking

CPU+FPAs+Acc for HPC



RISC-V Vision for EU HPC



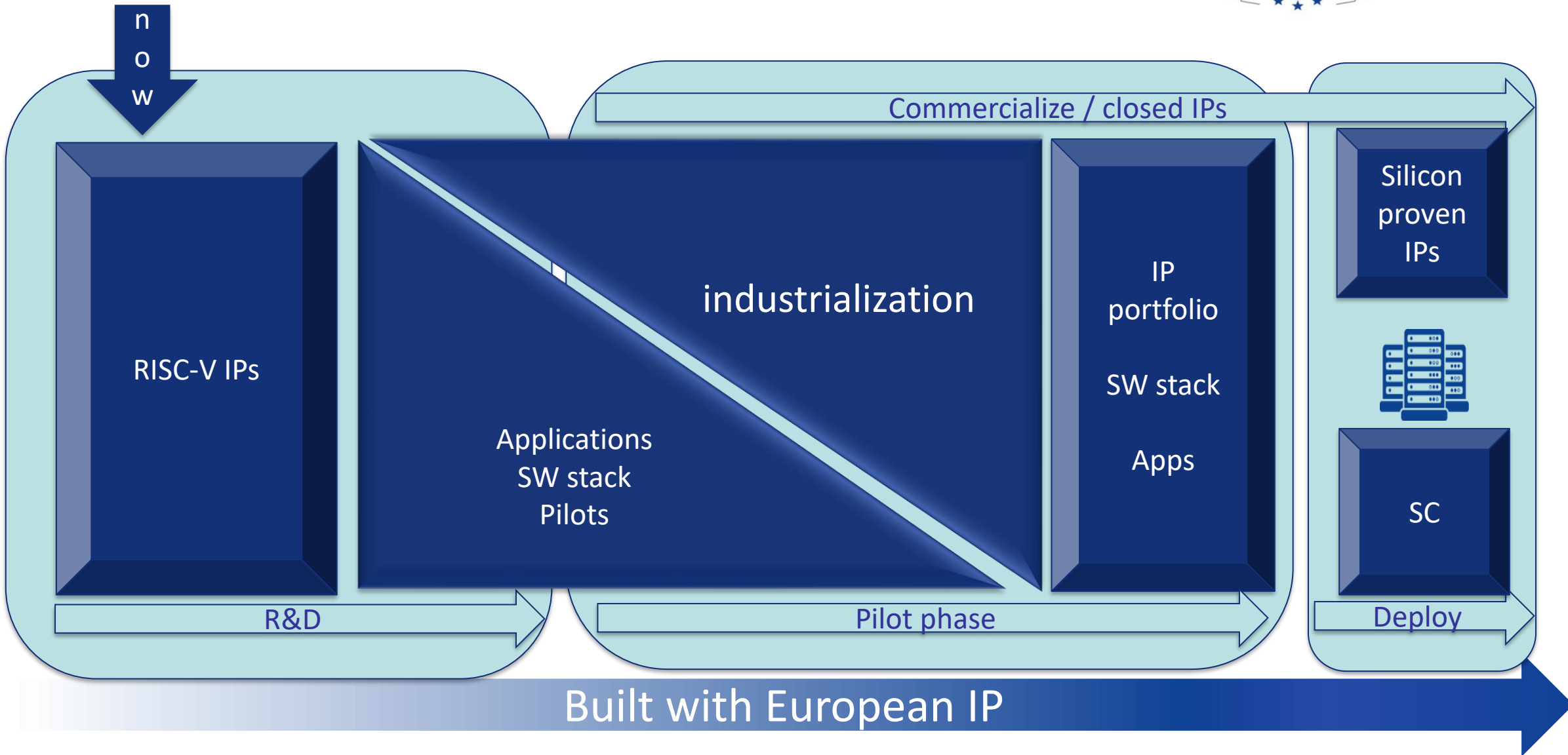
EuroHPC
Joint Undertaking

- **Strategic roadmap** towards the next gen of EU HPC technology with **RISC-V**
- **Inclusive Framework Partnership** as a nucleation point of RISC-V for HPC
- **Open-source** and **open standards** for HW/SW development to leverage on the world-wide **RISC-V ecosystem**
- **Pilot system** for HPC as an intermediate milestone
 - » RISC-V general purpose **processor**
 - » RISC-V **accelerator**
- Towards the first **European post-Exascale supercomputer using RISC-V**

RISC-V Roadmap



EuroHPC
Joint Undertaking



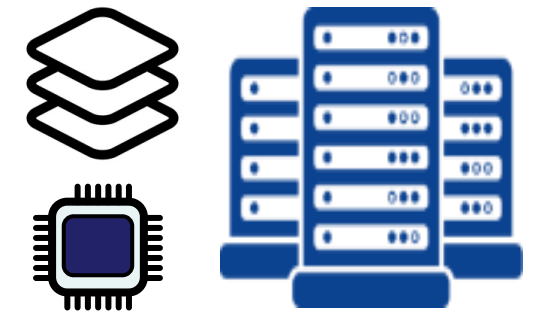
RISC-V Framework Partnership: Scope



EuroHPC
Joint Undertaking

Key outcomes

- **Coherent and strategic R&I roadmap**
 - » Based on the open RISC-V ISA
 - » Contribute to the European efforts for technological sovereignty in HPC
 - » Leverage efforts of EPI/EUPILOT/EUPEX/ePROCESSOR/MEEP/TRISTAN/ISOLDE
- **Design and production of a chip**
 - » RISC-V processors
 - » RISC-V accelerators
 - » Chiplet-based architecture
 - » Industry-level quality, verification, validation
- **Pilot/demonstrator system**
 - » integrating the developed technology



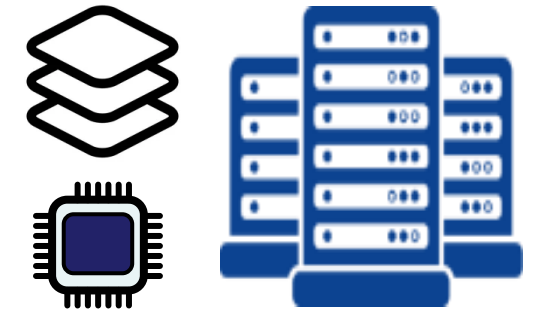
RISC-V Framework Partnership: Scope



EuroHPC
Joint Undertaking

Key outcomes

- **Software stack:**
 - » programming models and runtimes, libraries, tools, operating system components etc.
- **HPC applications**
 - » Industrial use cases
 - » Ported to the RISC-V environment
 - » Co-design
 - » Industry-level quality, verification
- **Specification and standardization**
 - » interfaces
 - » developed hardware
 - » developed software stack
- **Long-term roadmap for the European post-exascale era**

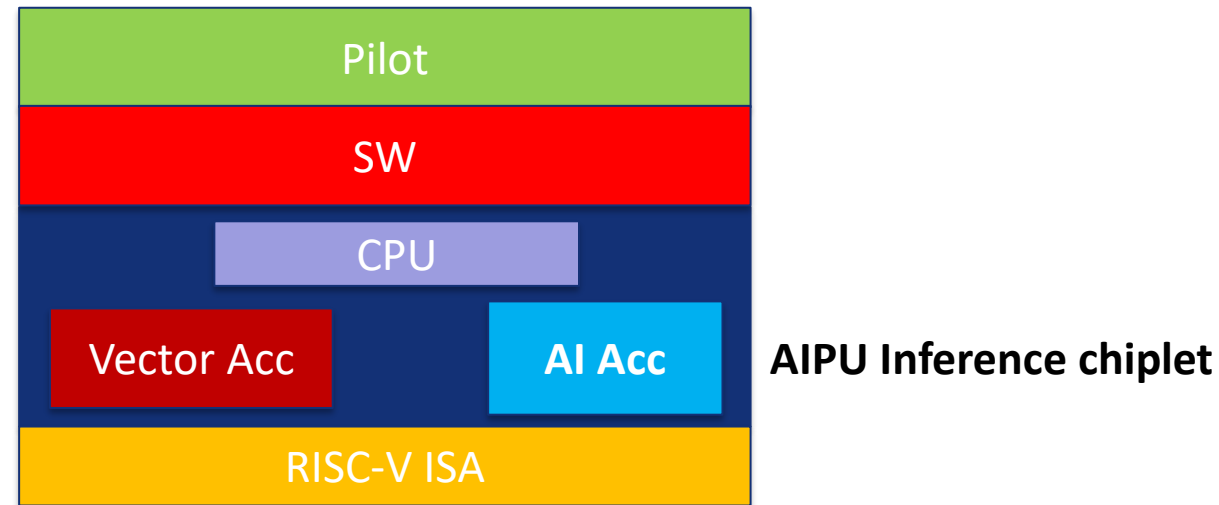


Digital Autonomy with RISC-V in Europe



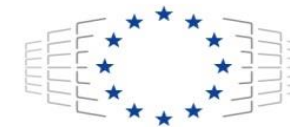
EuroHPC
Joint Undertaking

THE
EUPILLOT
EUPEX
European Pilot for Exascale

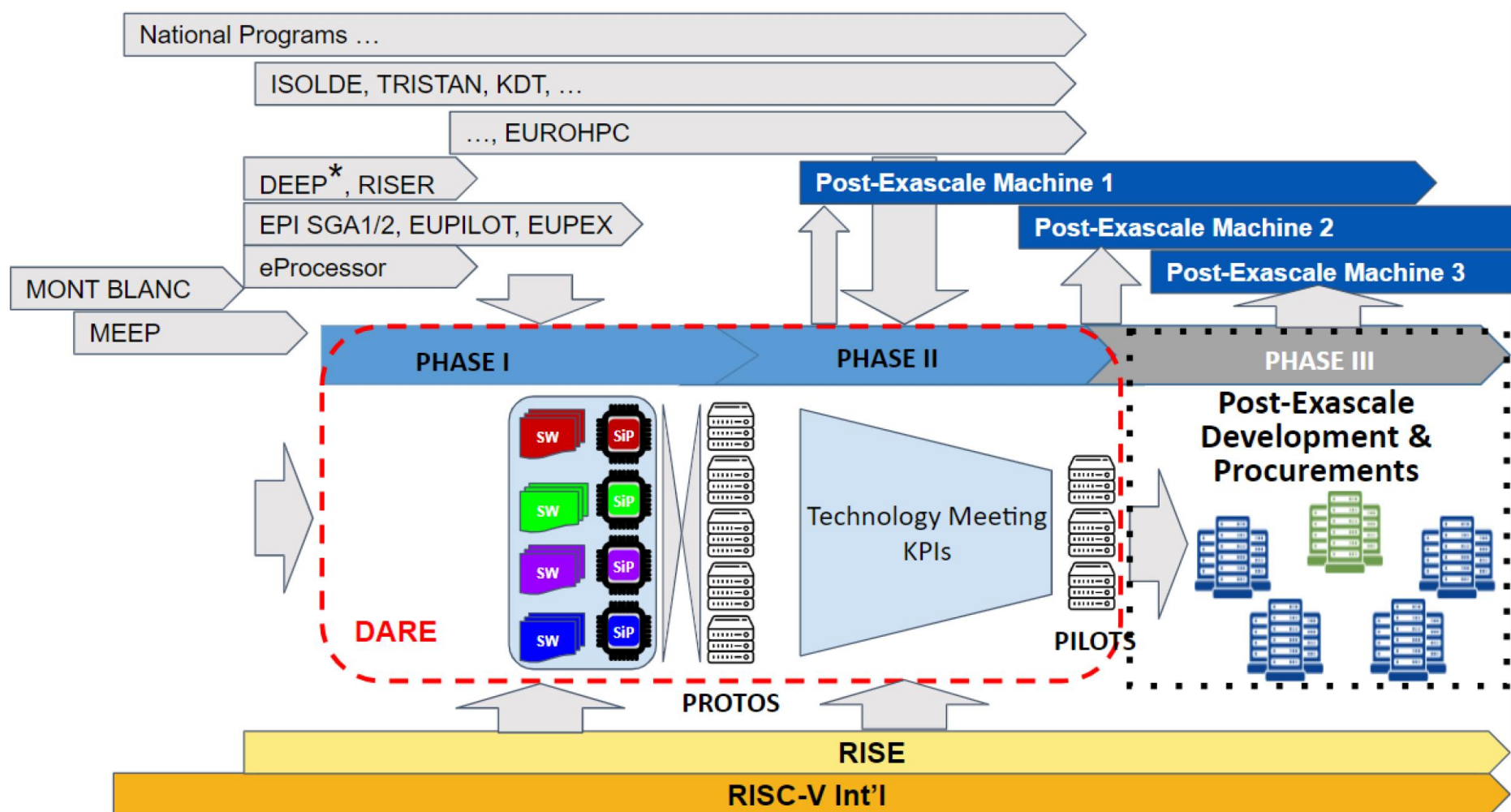


- **AI core** to address the heterogeneous nature of modern neural network workloads
 - **RISC-V**-controlled dataflow engine featuring several high-throughput data paths to provide balanced performance across a vast range of layers
 - Self-sufficient
 - Can execute all layers of a **neural network** without external interactions

Digital Autonomy with RISC-V in Europe



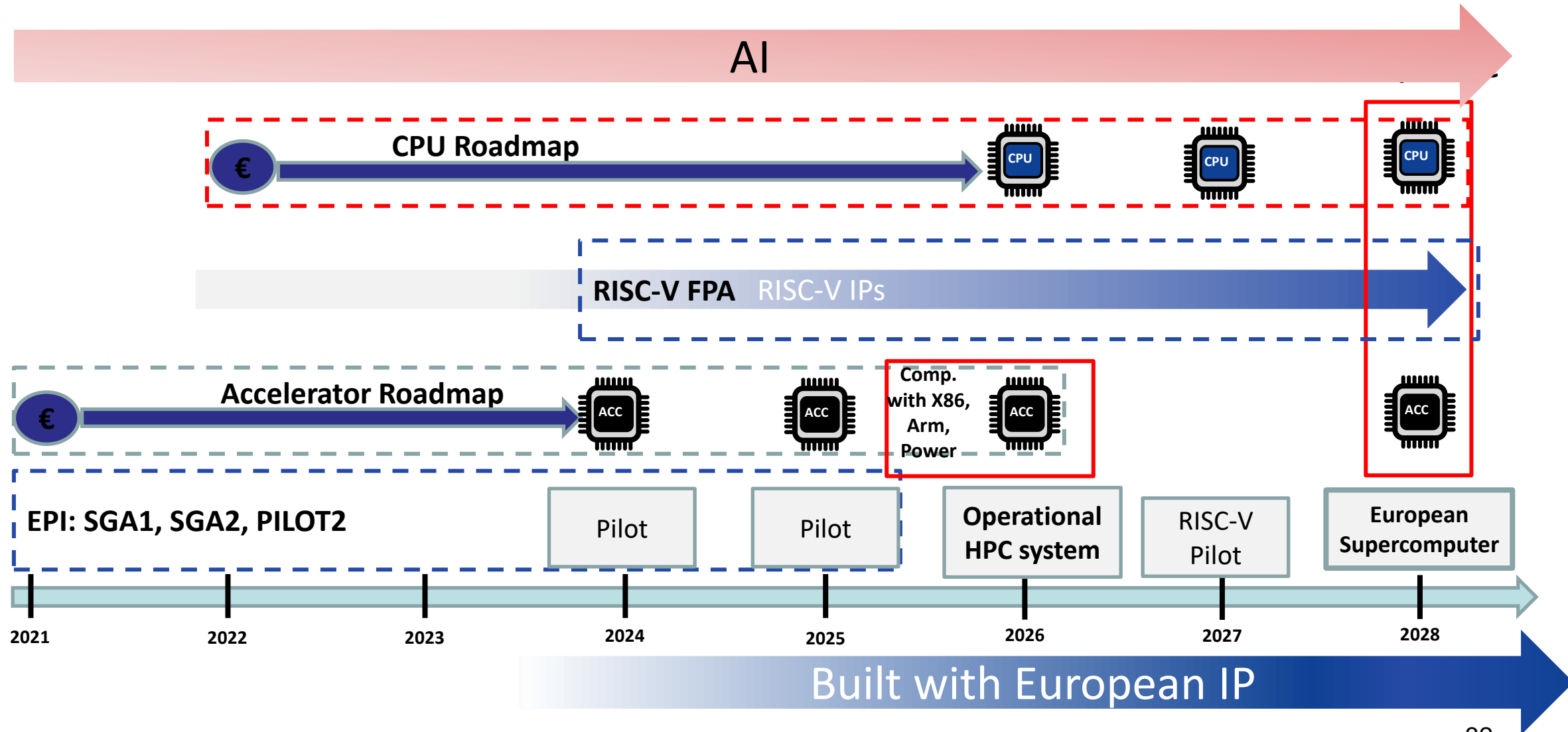
EuroHPC
Joint Undertaking



EuroHPC Chips Roadmap



EuroHPC
Joint Undertaking



Challenges



EuroHPC
Joint Undertaking

- Strict timelines
 - » What can be achieved with the limited time-frame?
- HW/SW co-design and tools not at the same level as competition
 - » EDA maturity
- System level HW/SW support
 - » Compatible components, not supportive Ips
 - » SW stack not mature enough
- Silicon challenges
 - » supply chain, expertise
- Industrial support within Europe?
 - » DARE to try or just but COTS?

The future



EuroHPC
Joint Undertaking



Procurement of AI factories – ‘one stop shop for AI applications’

Procurement of two additional quantum computers to be announced, with quantum chips development opportunities



Delivery of 2nd Exascale supercomputer: Alice Recoque supercomputer (Jules Vernes Consortium) in France, with European IP



Research and Development

- **AI SW stack and applications for exascale and quantum systems**
- **RISC-V Framework Partnership Agreement**
- **Benchmark framework**



Future Chips Calls - Stay vigilant!

Conclusions



EuroHPC
Joint Undertaking

- RISC-V is inevitable!
- **Support** from many EU countries necessary, for the future ecosystem
- **Inclusiveness** in participating in actions, from academia and industry
- **Consolidated effort** of EUROHPC-funded projects towards developing a diversity of technology with overlapping scope
- Clear and ambitious **vision and roadmap**



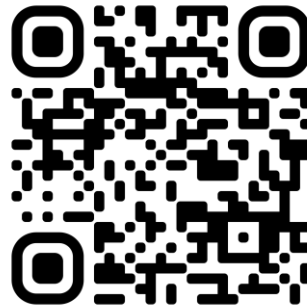
The European High Performance Computing Joint Undertaking

LEADING THE WAY IN EUROPEAN SUPERCOMPUTING

THANK YOU



For more information, feel free to visit our website and social media:



eurohpc-ju.europa.eu



[@euroHPC_JU](https://twitter.com/euroHPC_JU)

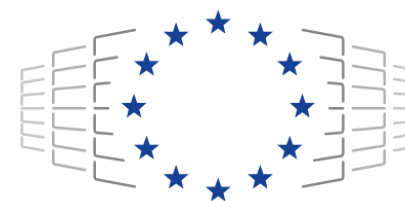


[eurohpc-ju](https://www.linkedin.com/company/eurohpc-ju)



[@eurohpc-ju](https://www.youtube.com/@eurohpc-ju)

EPI FORUM



EuroHPC
Joint Undertaking

PLATINUM SPONSORS



EVIDEN



GOLD SPONSORS

