HPC Perspectives and Challenges for Europe
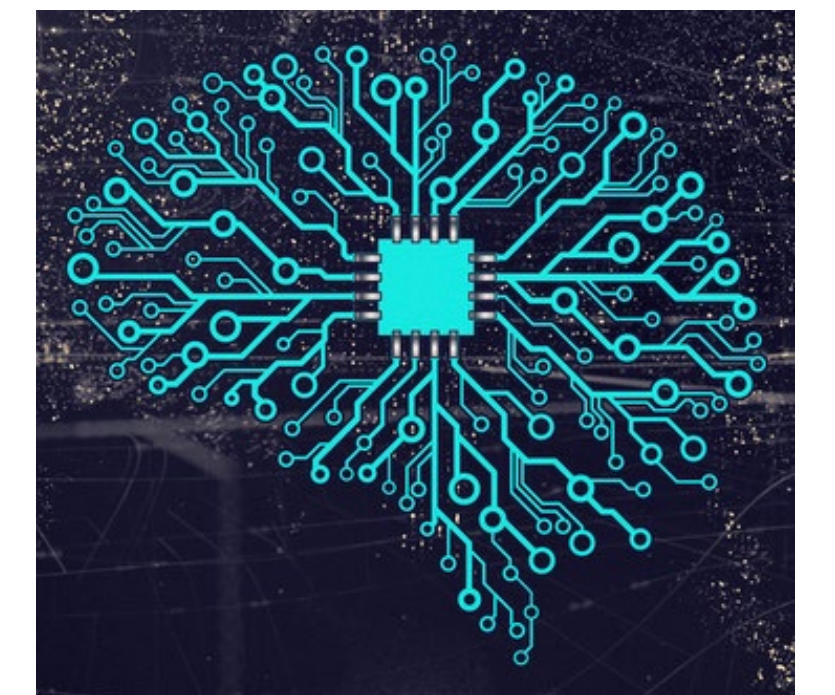
Professor Mateo Valero

Director, Barcelona Supercomputing Center
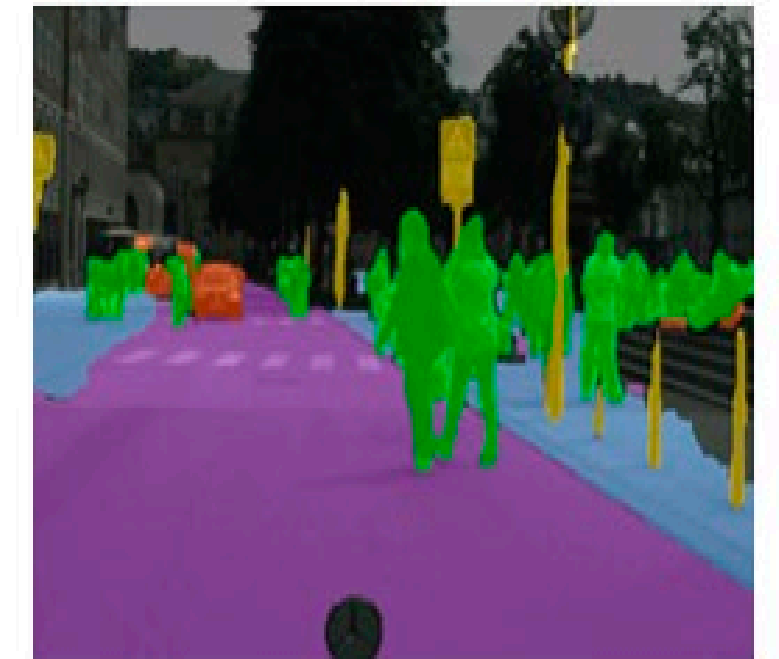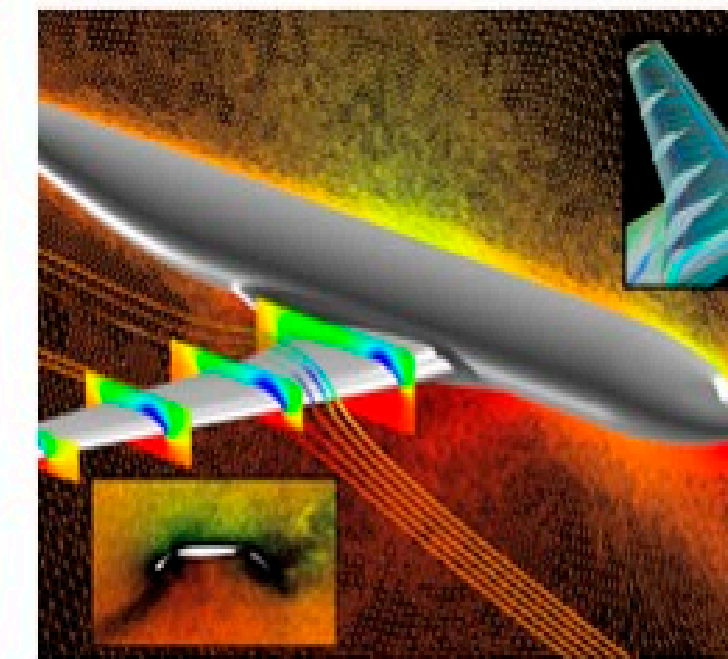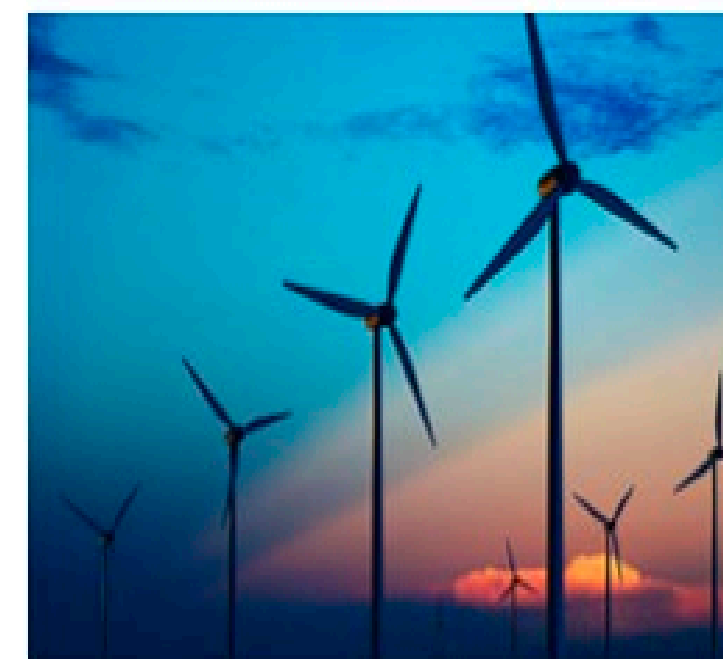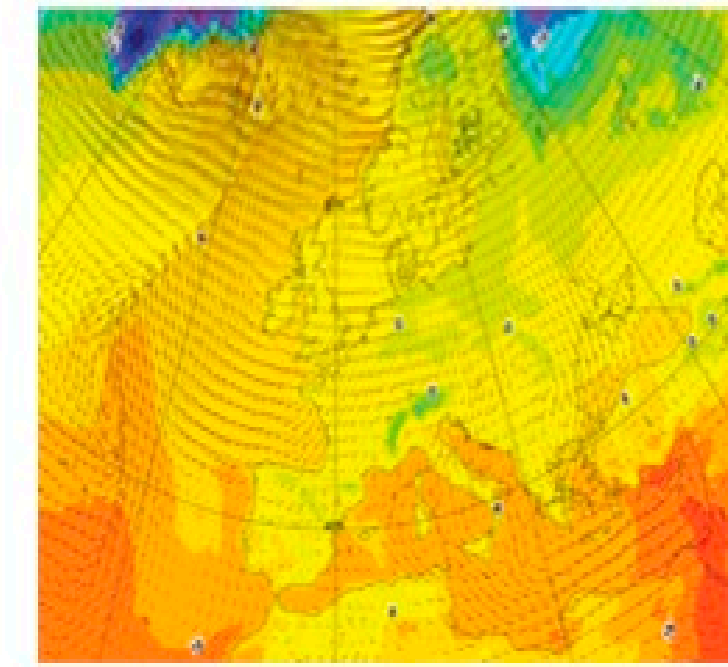
Some Context

- I was kindly invited by Roberto Viola to give a talk at ICT in Lisbon in October 2015

- I tried to emphasise the importance of HPC and of producing European technology

- A lot has happened since then…

Some Societal Challenges

- Aging population
- Climate change
- Cybersecurity
- Increasing energy needs
- Intensifying global competition
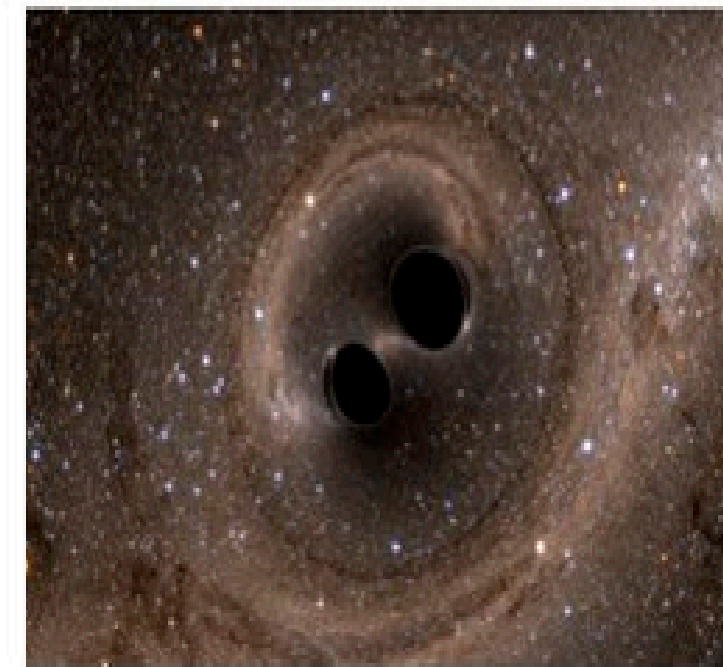
Images courtesy of The PRACE Scientific Steering Committee, "The Scientific Case for Computing in Europe 2018-2026"

Why is HPC Needed?

- Will save billions by helping us to adapt to climate change

- Will improve human health by enabling personalized medicine

- Will improve fuel efficiency of aircraft & help design better wind turbines

- Will help us to understand how the human brain works
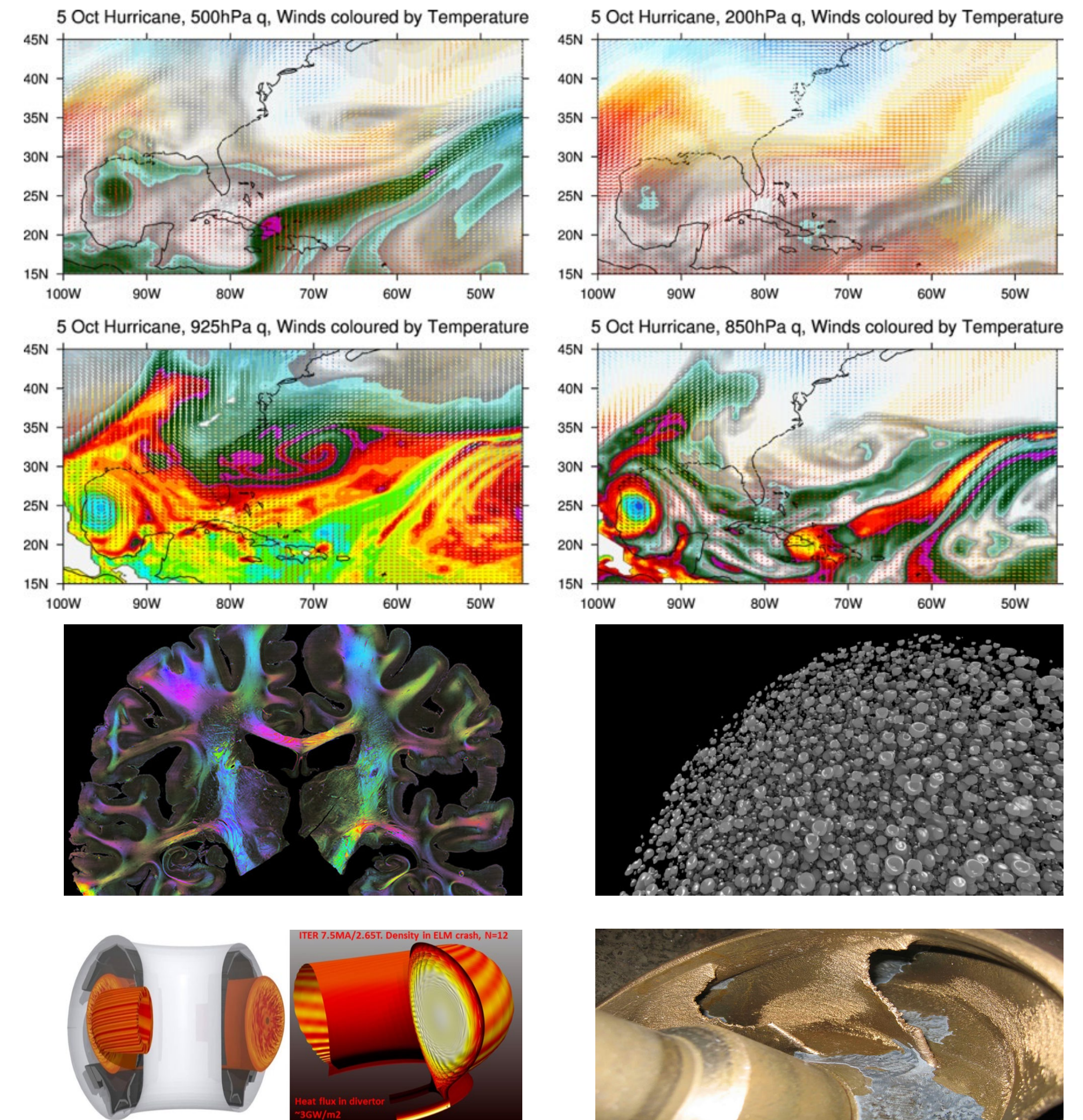
Images courtesy of The PRACE Scientific Steering Committee, "The Scientific Case for Computing in Europe 2018-2026"

Update on the Race for Exascale
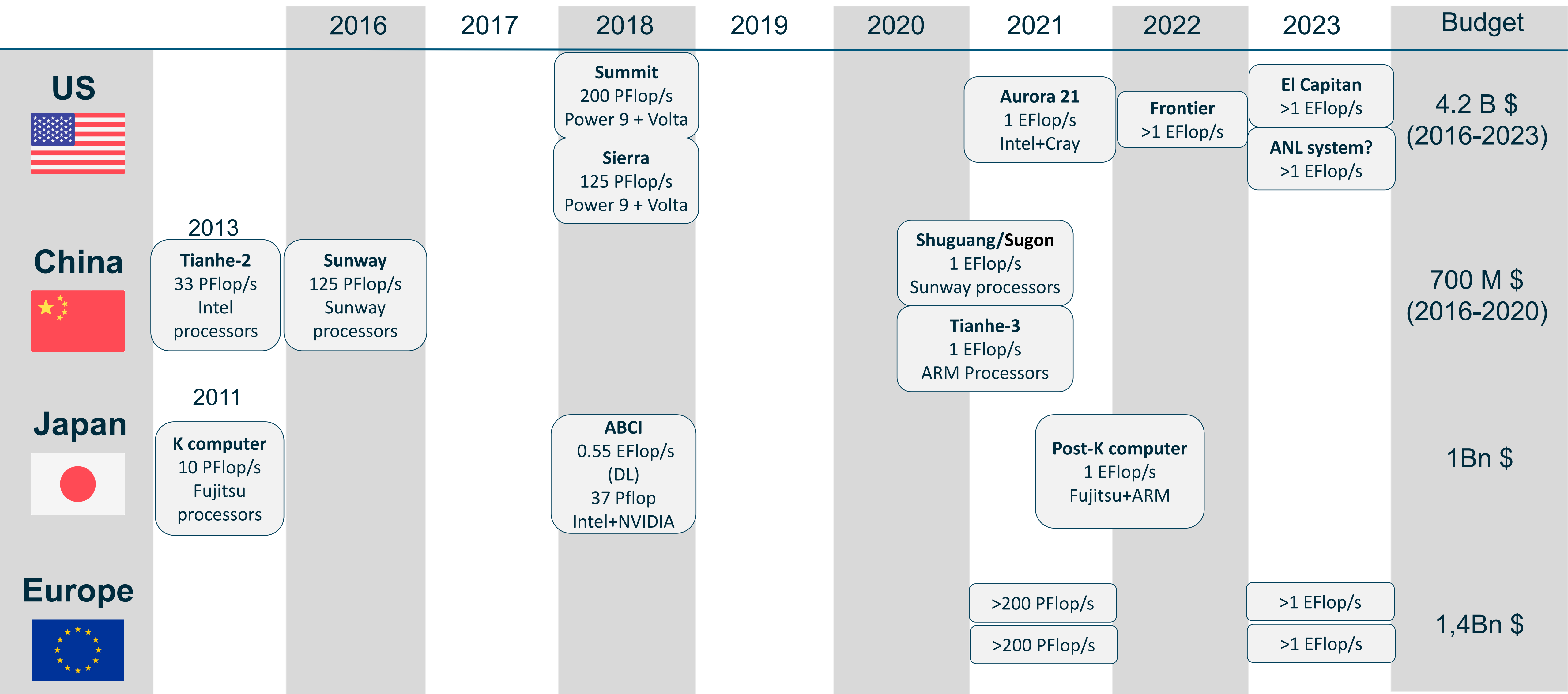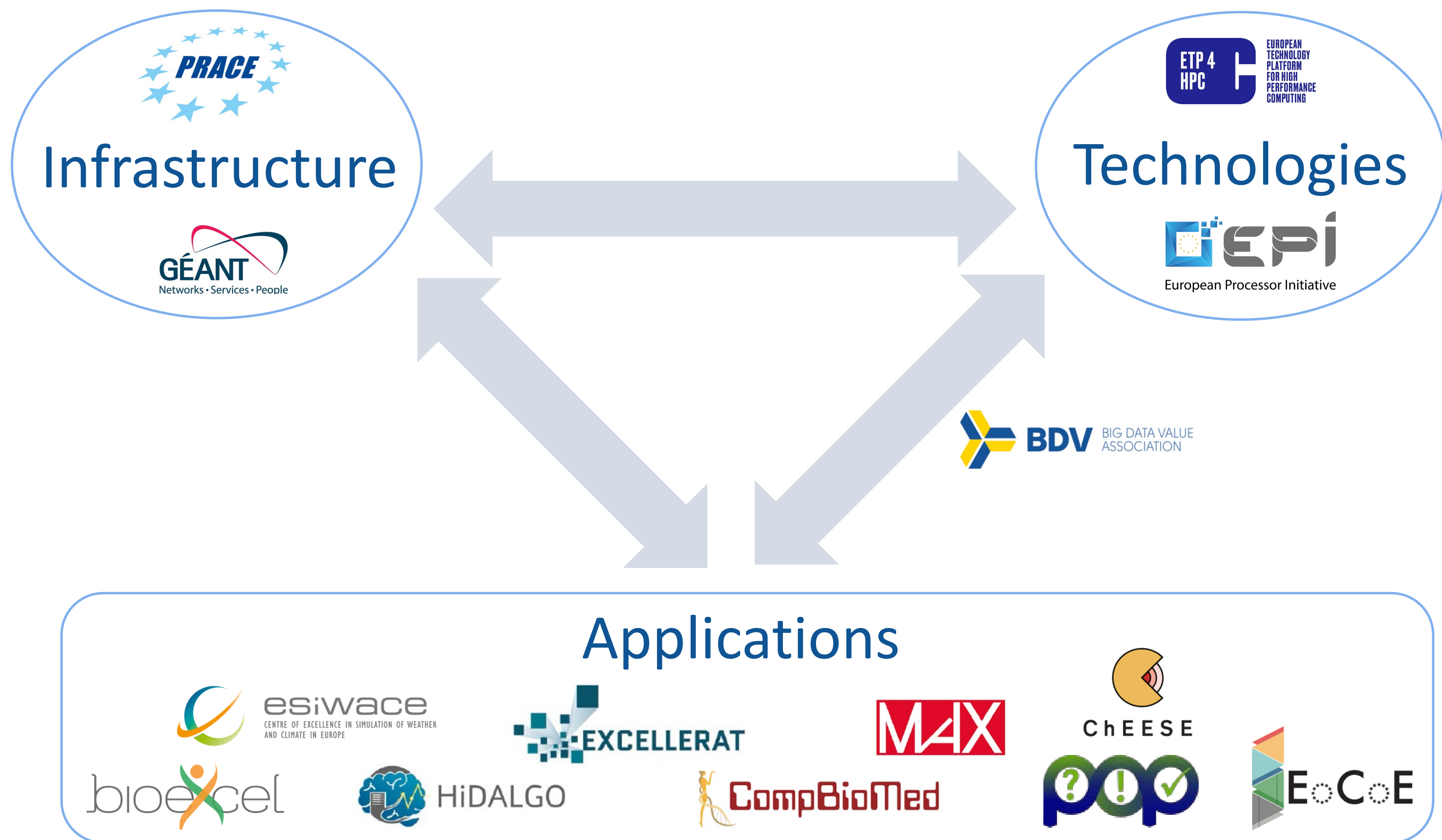
		2016	2017	2018	2019	2020	2021	2022	2023	Budget
US				Summit 200 PFlop/s Power 9 + Volta			Aurora 21 1 EFlop/s Intel+Cray	Frontier >1 EFlop/s	El Capitan >1 EFlop/s	4.2 B $ (2016-2023)
				Sierra 125 PFlop/s Power 9 + Volta					ANL system? >1 EFlop/s	
China	2013	Tianhe-2 33 PFlop/s Intel processors	Sunway 125 PFlop/s Sunway processors			Shuguang/Sugon 1 EFlop/s Sunway processors				700 M $ (2016-2020)
						Tianhe-3 1 EFlop/s ARM Processors				
Japan	2011	K computer 10 PFlop/s Fujitsu processors		ABCI 0.55 EFlop/s (DL) 37 Pflop Intel+NVIDIA			Post-K computer 1 EFlop/s Fujitsu+ARM			1Bn $
Europe						>200 PFlop/s			>1 EFlop/s	1,4Bn $
						>200 PFlop/s			>1 EFlop/s	

Current European HPC Ecosystem

Where Europe needs to be stronger

- Only 1 of the 10 most powerful HPC systems is in the EU

- HPC codes must be upgraded

- Vital HPC hardware elements are missing: General Purpose Processor and Accelerators

- EU needs its own source of as many of the system elements as possible

Why Europe needs its own Processors

- Processors now control almost every aspect of our lives

- **Security** (back doors etc.)

- Possible **future restrictions on exports to EU** due to increasing protectionism

- **A competitive EU supply chain** for HPC technologies will create jobs and growth in Europe

Amazon exec and Super Micro CEO call retraction of spy chip story

'[Tim Cook] is right. Bloomberg story is wrong about Amazon, too.'

NSA May Have Backdoors Built Into Intel And AMD Processors

The US Cloud Act v The EU's GDPR - Data Privacy & Security

A group of researchers showed how a Tesla Model S can be hacked and stolen in seconds using only $600 worth of equipment

A jet sale to Egypt is being blocked by a US regulation, and France is over it

USA TODAY

Car hacking remains a very real threat as autos become ever more loaded with tech
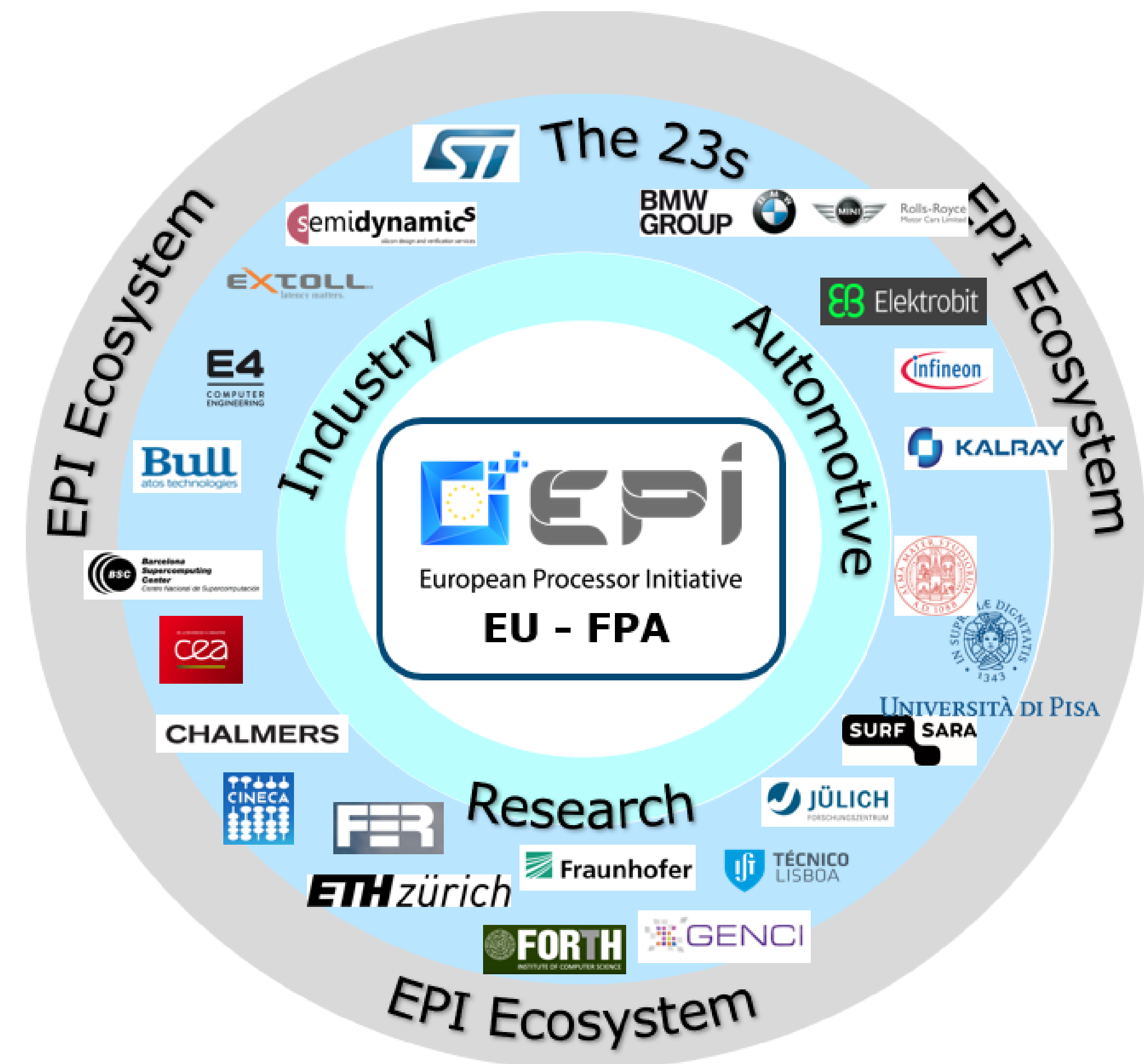
Images courtesy of European Processor Initiative

How EuroHPC will help to make us stronger

- Developing a new European supercomputing ecosystem: HPC systems, network, software, applications, access through the cloud

- Making HPC resources available to public and private users, including SMEs.

- Stimulating a technology supply industry

EuroHPC & EPI (European Processor Initiative)

- High Performance General Purpose Processor for HPC

- High-performance RISC-V based accelerator

- Computing platform for autonomous cars

- Will also target the AI, Big Data and other markets in order to be economically sustainable

Images courtesy of European Processor Initiative

The Open-Source Hardware Opportunity

- In 2015 I said I believed a European Supercomputer based on ARM was possible (Mont-Blanc).

- Even though ARM is no longer European, it can form part of the short-term solution

- The fastest-growing movement in computing at the moment is Open-Source and is called RISC-V

- The future is Open and RISC-V is democratising chip-design
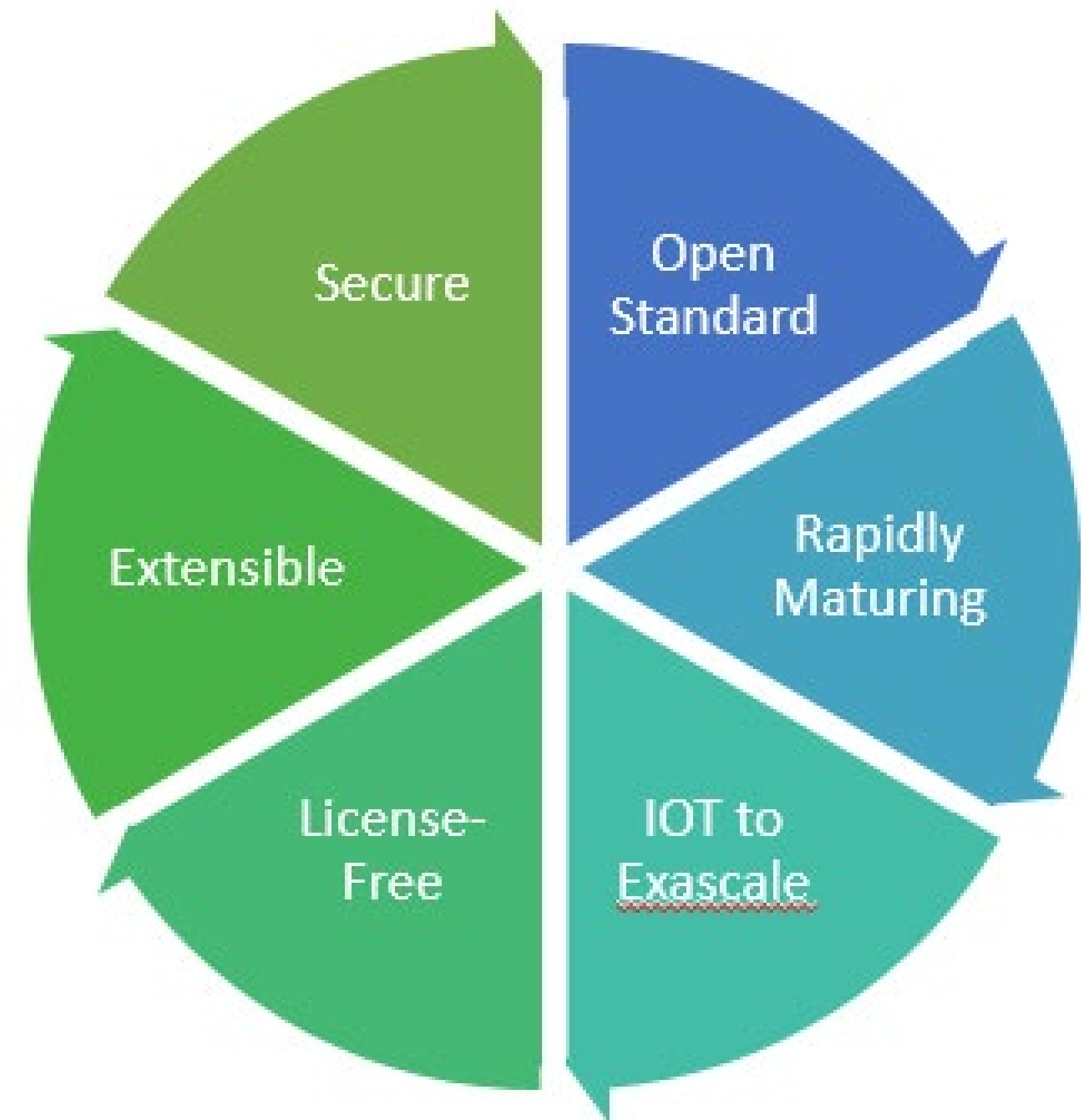
New Paradigms for Exascale

- Increasingly complex and heterogeneous hardware, including AI, Neuromorphic, Quantum and other accelerators. New memory systems and hierarchies

- Will require a monumental effort to redesign system software and applications for Exascale systems

- AI will be essential to harness the complexity of future Exascale systems
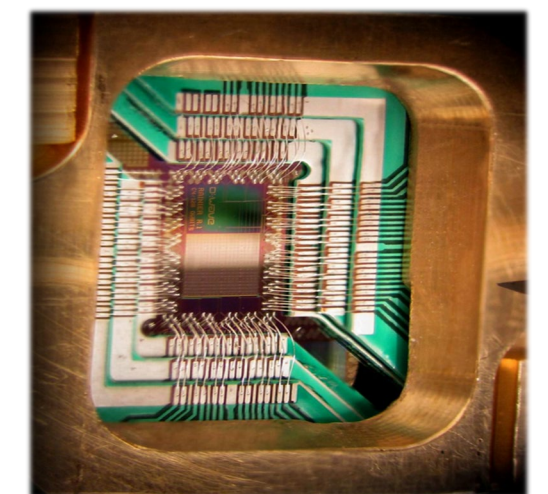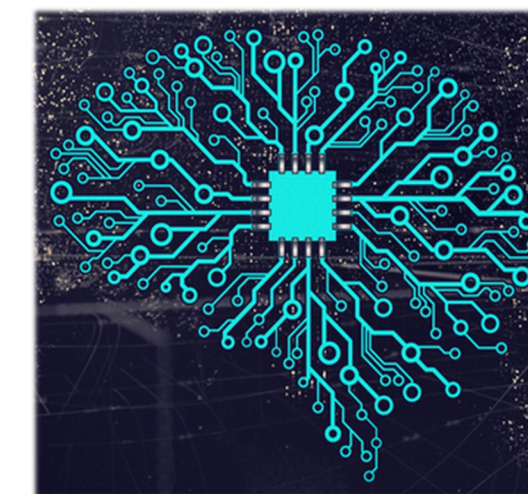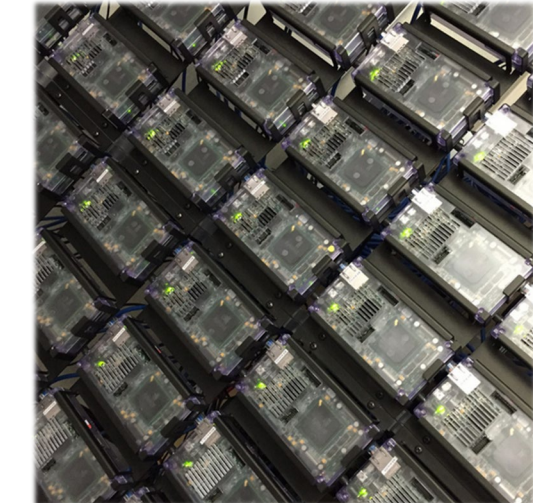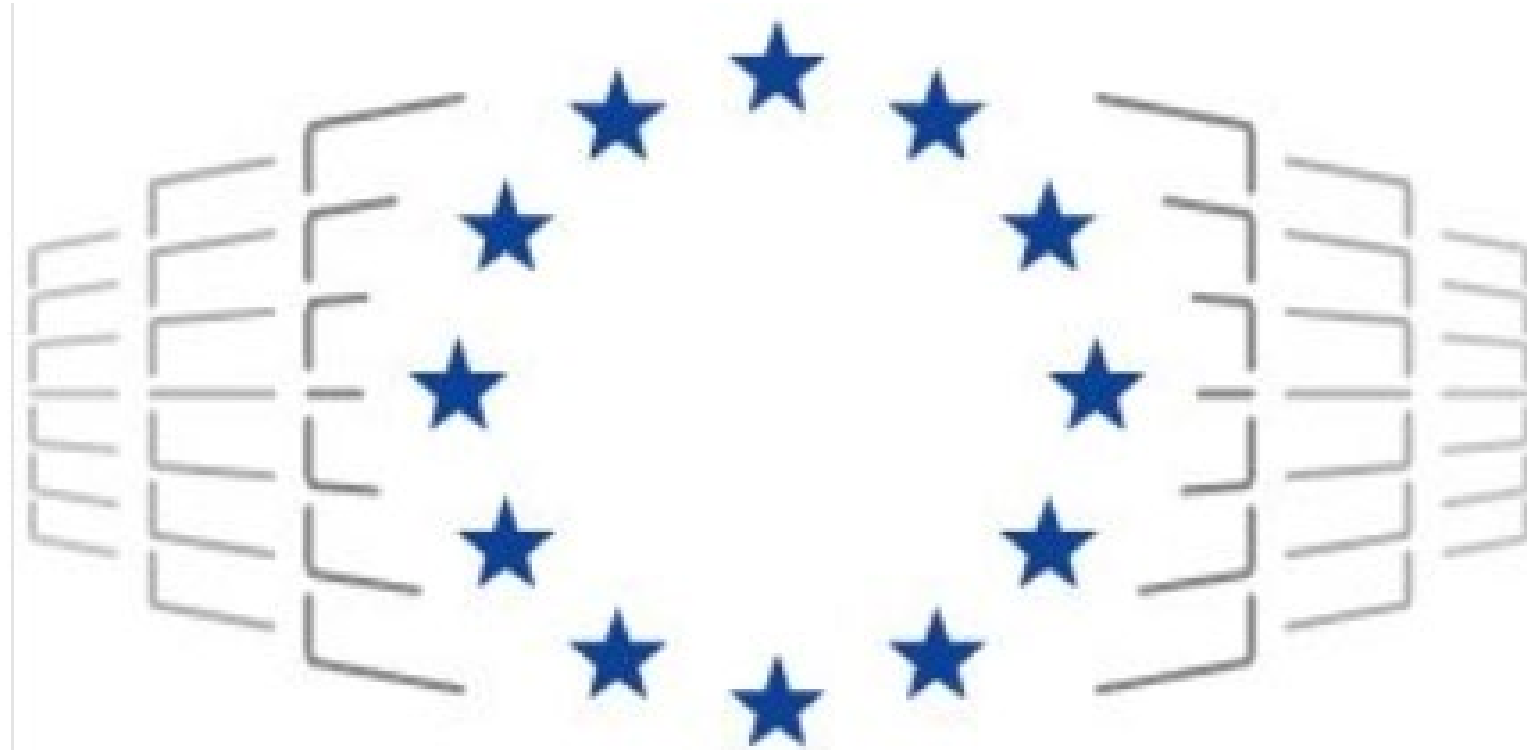
Conclusion

- HPC is crucial to resolve societal challenges and preserve European competitiveness

- Europe is going in the right direction with EuroHPC. This must be sustained in the long-term

- The chip design effort must continue for the EU's security and competitiveness, and should create a processor ecosystem covering IoT, servers, cloud, autonomous connected vehicles and HPC

EuroHPC opens a window of opportunity to create the Airbus/Galileo of HPC