



# The European High Performance Computing Joint Undertaking

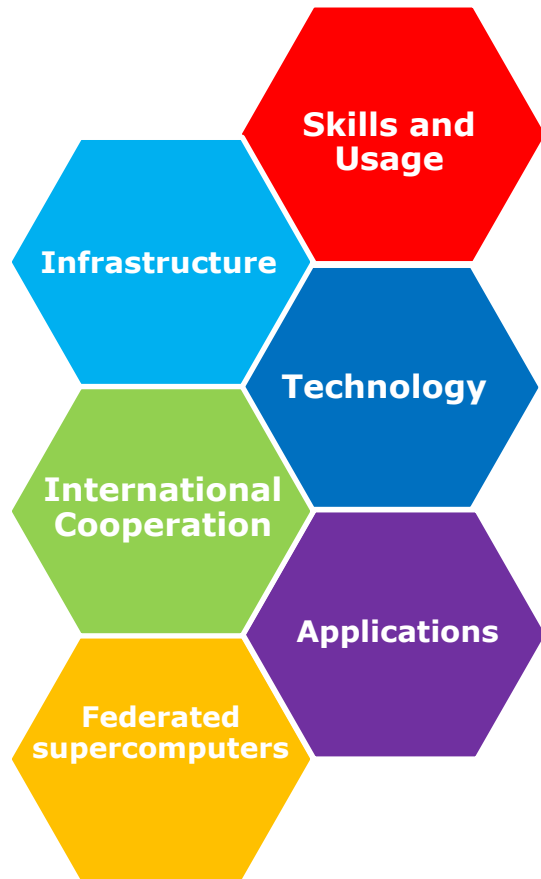
## **EuroHPC – Scientific Infrastructure Eyes**

3<sup>rd</sup> International Workshop on the Future of Computing | 21.12.2023 | Dr. R. S. Chatwell

# What, where and when is EuroHPC ?

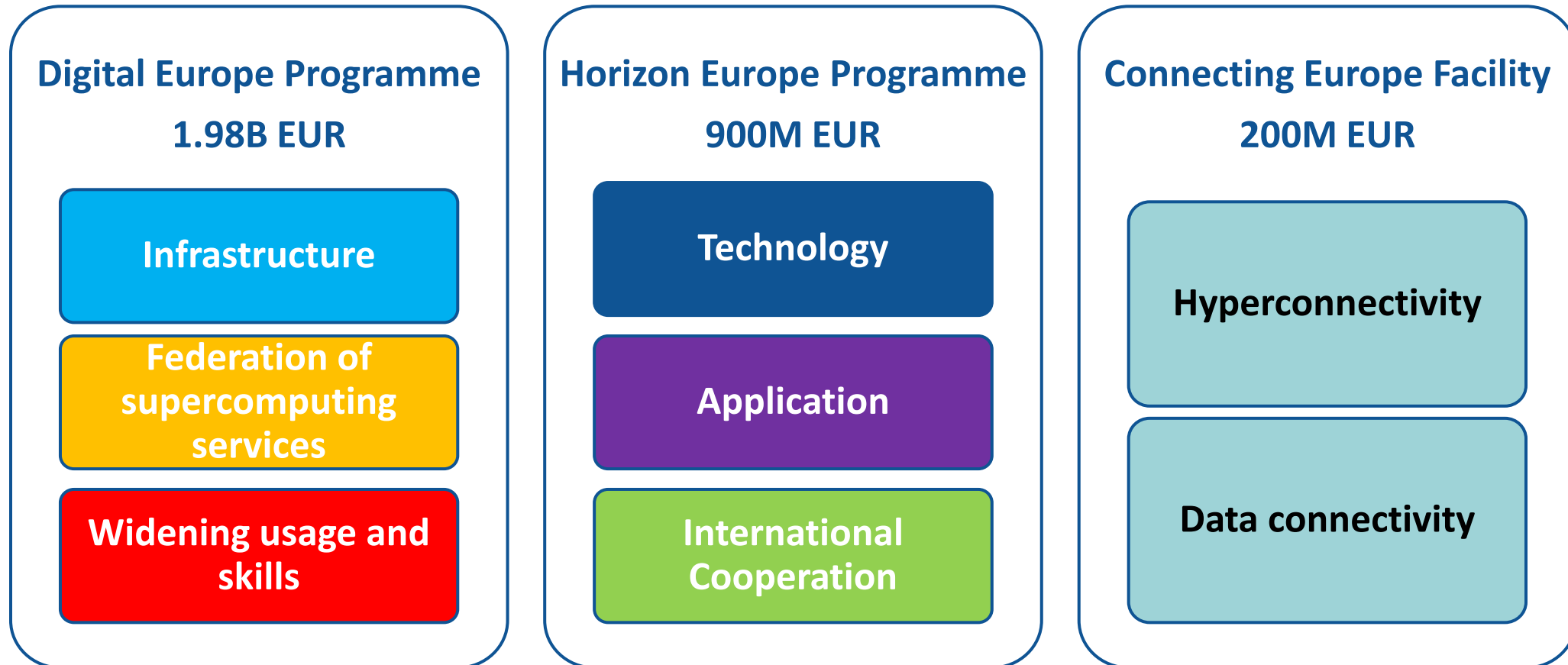


**EuroHPC**  
Joint Undertaking



- Legal EU body acting as **funding entity**, created in 2018 out of the European Commission and granted **full autonomy** in 2020
- Main mission is to **pool resources** from all 34 Participating States to **develop, deploy, maintain** and **extend** a world-leading supercomputing and quantum computing infrastructure in Europe
- We are operating in a **co-funding paradigm** and are guided by the “**6 Pillars of Action**”
- We are based in **Luxembourg** and are currently a team of 35 employees from 17 different countries

# Funding structure in MFF: 2021 - 2027



**7 Billion Euro in total following the co-funding paradigm**  
(with 3.5 Billion Euro coming from national funds and private member)

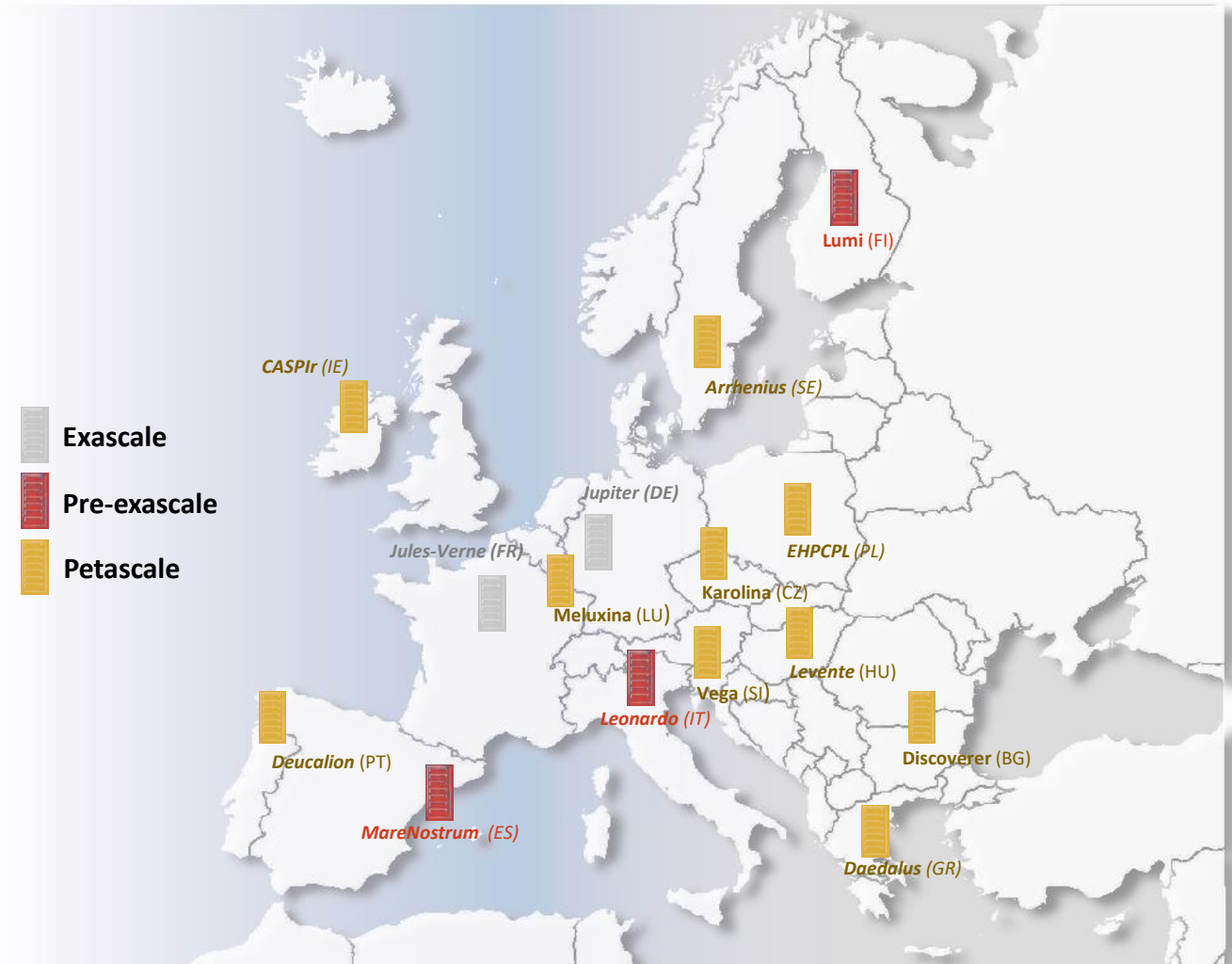
# EuroHPC Supercomputing Fleet

Infrastructure



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- **15 systems** in different performance classes
- **2 Exascale Supercomputers**
  - *Jules-Verne (France)* \*
  - *Jupiter (Germany)* \*
- **3 Pre-exascale Supercomputers**
  - LUMI (Finland) (5<sup>th</sup> Top 500) †
  - Leonardo (Italy) (6<sup>th</sup> Top 500) †
  - MareNostrum 5 (Spain) (8<sup>th</sup> Top 500) †
- **9 Petascale Supercomputers**
  - *Deucalion (Portugal)*
  - *Discoverer (Bulgaria)*
  - *Karolina (Czech Republic)*
  - *Meluxina (Luxemburg)*
  - *Vega (Slovenia)*
  - *CASPIr (Ireland)* \*
  - *EHPCPL (Poland)* \*
  - *Levente (Hungary)* \*
  - *Daedalus (Greece)* \*
  - *Arrhenius (Sweden)*
- **Total investment: > 2.1 Billion EUR**



\*) System not yet fully installed or operational †) Top500 list from November 2023

# Access to EuroHPC systems

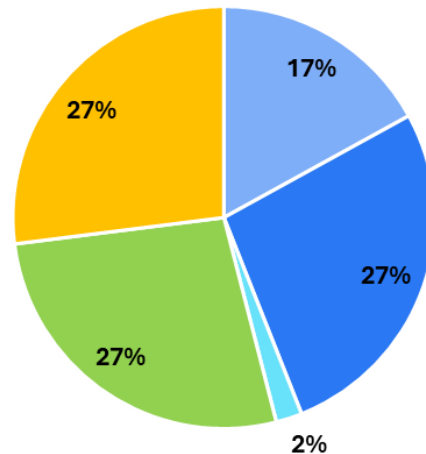
Infrastructure



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## Regular Access

**RESEARCH DOMAINS DISTRIBUTION FOR AWARDED PROJECTS**  
(across all Regular Access cut-offs)



- Biochemistry, Bioinformatics, Life Sciences, Physiology and Medicine
- Chemical Sciences and Materials, Solid State Physics
- Earth System Sciences
- Computational Physics: Universe Sciences, Fundamental Constituents of Matter
- Engineering, Mathematics and Computer Sciences

**CORE HOURS AWARDED FOR REGULAR ACCESS**  
(across all cut-offs, up to March 23)

| Awarded resources           |                      |
|-----------------------------|----------------------|
| HPC Centre                  | Core hours awarded   |
| Vega (IZUM (SI))            | 481.117.087          |
| Karolina (IT4I (CZ))        | 206.900.667          |
| Discoverer (SofiaTech (BG)) | 278.031.306          |
| MeluXina (LuxProvide (LU))  | 192.458.296          |
| LUMI (CSC (FI))             | 765.204.76           |
| <b>TOTAL</b>                | <b>1.923.712.332</b> |

# Access to EuroHPC systems

Infrastructure



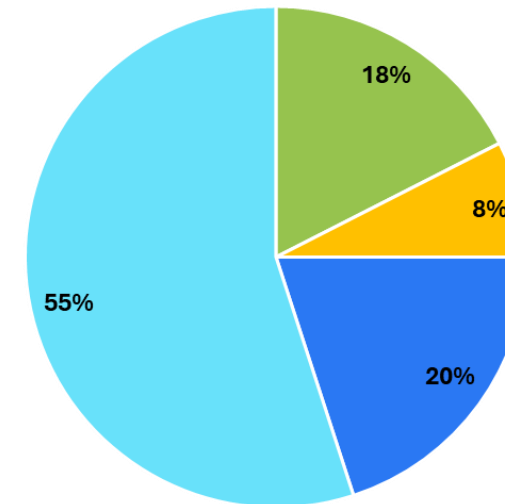
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## Extreme Scale Access

Total core hours awarded across all systems:  
**2,885,790,912**

Total node hours awarded across all systems:  
**41,914,156**

### RESEARCH DOMAINS DISTRIBUTION FOR AWARDED PROJECTS (across all Extreme Scale Access cut-offs)



- Chemical Sciences and Materials, Solid State Physics
- Earth System Sciences & Environmental Studies
- Engineering, Mathematics and Computer Sciences
- Computational Physics: Universe Sciences, Fundamental Constituents of Matter

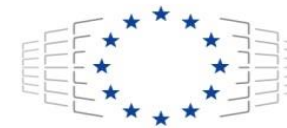
# EuroHPC QCS Infrastructure

- **2 Quantum Simulators\* (100+ Qubits)**
  - Jülich: *Jewels* – PASQAL QS (Germany)
  - GENCI: *Joliot-Curie* – PASQAL QS (France)
  - Both systems will be delivered in January 2024
- **6 Selected Hosting “Entities” (Consortia of 30 participating countries)**
  - Euro-Q-Exa, *superconducting Qubits* (DE)
  - LUMI-Q, *superconducting Qubits* (CZ)
  - EuroQCS-Spain, *superconducting Qubits* (ES)<sup>†</sup>
  - EuroQCS-Italy, *neutral atom Qubits* (IT)<sup>\*</sup>
  - EuroQCS-Poland, *trapped ion Qubits* (PL)
  - EuroQCS-France, *photonic Qubits* (FR)
- **Total investment > 140 Million EUR**



\* ) Analogue Quantum Simulator † ) Analogue Quantum Annealer

# EUROHPC-2022-CEI-QC-01



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## Call for Expression of Interest for Hosting Entities for quantum computers

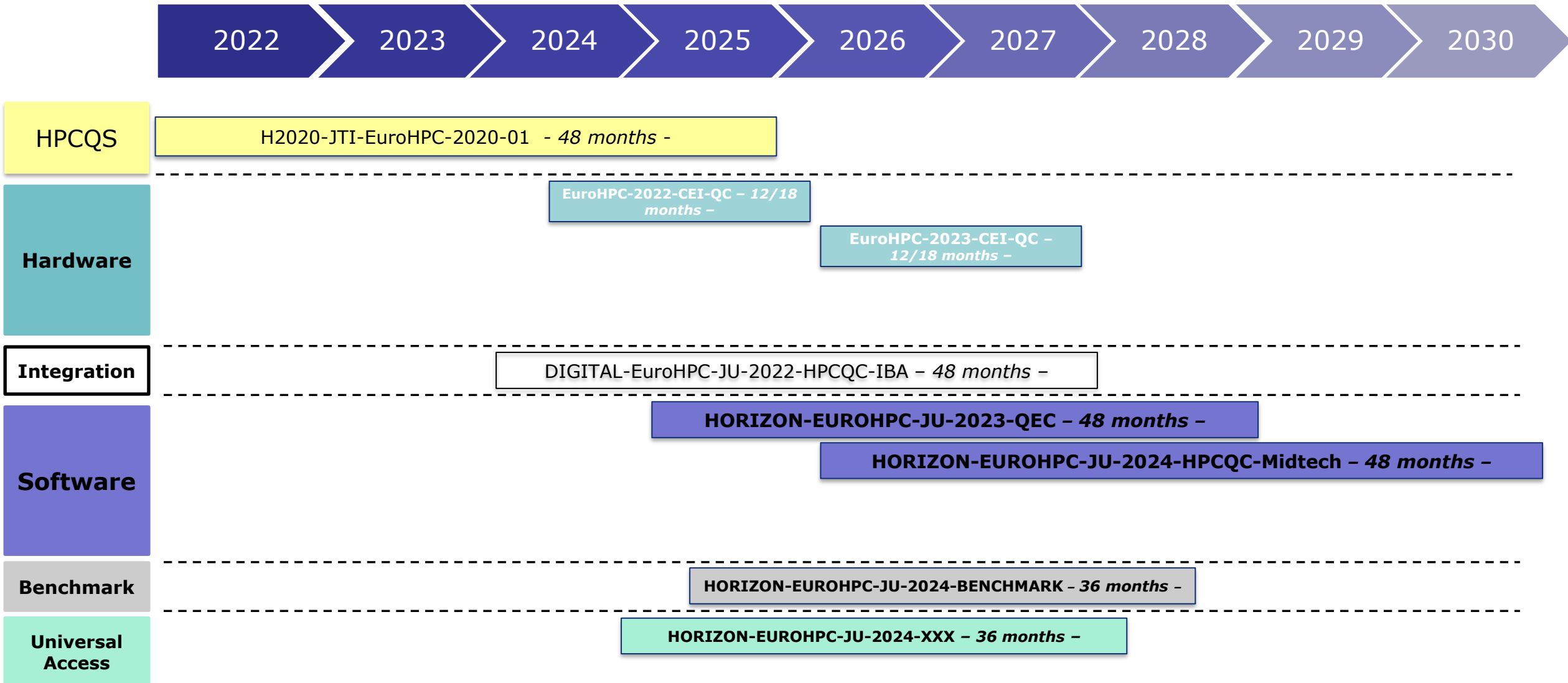
### Overview on the status of the tender procedure for each Hosting Entity

| Proposal Acronym | Qubit representation + (Number of Qubits) | Tender Value [Mio.EUR] | Status           | Publishing Date | Closing Date | Evaluation Finalised (indicative) |
|------------------|---|------------------------|------------------|-----------------|--------------|-----------------------------------|
| EuroQCS-Poland   | Ion-trap (20)                             | 12.95                  | Under evaluation | 16/10/2023      | 22/11/2023   | 08/01/2024                        |
| Euro-Q-Exa       | Superconducting (50 / 100)                | 42.00                  | Open for tender  | 24/11/2023      | 22/01/2024   | 29/02/2024                        |
| EuroQCS-France   | Photonic (10)                             | 11.40                  | Finalisation     | <i>TBA</i>      | <i>TBA</i>   |                                   |
| LUMI-Q           | Superconducting (20)                      | 7.00                   | Finalisation     | <i>TBA</i>      | <i>TBA</i>   |                                   |
| EuroQCS-Italy    | Neutral Atoms (100 / 120)                 | 19.00                  | Finalisation     | <i>TBA</i>      | <i>TBA</i>   |                                   |
| EuroQCS-Spain    | Superconducting Flux - Annealing (10)     | 8.50                   | Finalisation     | <i>TBA</i>      | <i>TBA</i>   |                                   |

# Quantum Computing Activities as of 2023



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# Standardisation as key strategic goal



## 1.) HPC-QC Integration (Starting in Q1 2024)

- **Integration** of Quantum Computers and -Simulators into HPC data-centres as **accelerator platforms** (operational HPC performance of at least 4 Peta FLOPS)
- Initially loose integration with two separate Software Stacks and a defined HPC – QC interface
- **Foreseen standardisation** efforts on Interfaces, i.e. low level API, management/control interface, job/user management + monitoring)

## 2.) 2<sup>nd</sup> Call-for-Expression-of Interest (CFEI )to Host an EuroHPC Quantum Computer (19/12/2023)

- Foreseen systems must at least have 10 physical Qubits
- 2-Qubit Gate error rate < 1%
- Qubit readout fidelities > 95%
- Focus on platforms that have not been considered in 1<sup>st</sup> CFEI

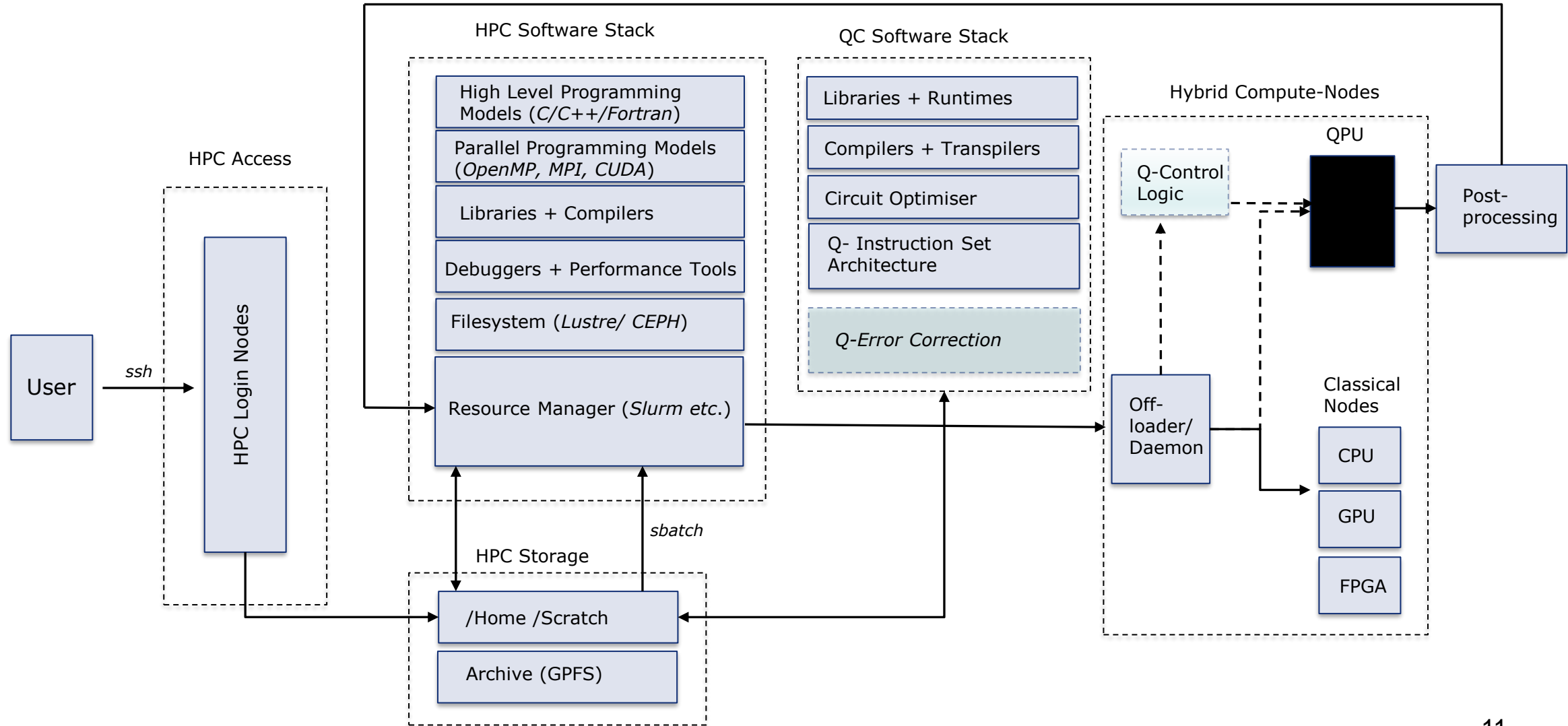
## 3.) HPC-QC Middleware (Starting in Q1/Q2 2026)

- Development of a **technology agnostic** software stack (between physical execution – and application layer)
- Developments of Error correction methods (postprocessing through HPC)
- Tighter Integration and targeted convergence towards a hybrid Software Stack
- **Foreseen standardisation** efforts on Resource- and Load Managers, Libraries, Compilers, Transpilers

# "Hybrid" HPC-QC Software Stack



Post-processing through HPC resources



A wireframe bear is shown in a server room setting. The bear is composed of a network of blue lines forming its shape. The background features server racks with glowing blue lights and vertical lines, creating a futuristic, digital atmosphere.

# Dziękuję !

Keep up to date with all EuroHPC JU news!



<https://eurohpc-ju.europa.eu>



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