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PART 8/21

COMMISSION STAFF WORKING DOCUMENT

EVALUATION

Interim Evaluation of the Horizon Europe Framework Programme for Research and Innovation (2021 - 2024)

Accompanying the document

Communication from the Commission to the European Parliament and the Council

Horizon Europe: Research and Innovation at the heart of competitiveness

{COM(2025) 189 final}

Annex 16: Evaluation of EuroHPC JU

Annex to the Commission's interim evaluation of Horizon Europe

Contents

This is the evaluation for **the European High Performance Computing joint undertaking (EuroHPC)**, which covers both the previous (2014-2020) and the current multiannual financial framework (MFF) (2021-2027). The EuroHPC was established in 2018 by Regulation (EU) 2018/1488, and by Regulation (EU) 2021/1173 (that builds and repeals the previous Regulation (EU) 2018/1488), to operate under the current MFF. It was recently amended by the Council Regulation (EU) 2024/1732 of 17 June 2024. An interim evaluation support study of the EuroHPC has informed this report[1].

1. Effectiveness

The interim evaluation support study of the EuroHPC (the study) states that 'to date, the EuroHPC has had an immense impact on the development of the European sovereign HPC ecosystem at the R&I, infrastructure, and socio-economic levels and helped to strengthen its global positioning. All the procured EuroHPC systems in operation up to July 2023 have been very successful in terms of the appearance in the TOP500 list of supercomputers, demonstrating a high level of global competitiveness of these systems. In addition to the procurement and R&I, the contribution to technological advancement and community building has been expected[2].' and 'The activities have been in line with the FP objectives and seem to have met the JU's objectives according to its defined strategic roadmap[3]'.

EuroHPC[4] has successfully mobilised substantial joint investments with critical mass by the European Commission and Member States to support ambitious goals, which aim to establish the EU as a world power in supercomputing[5] and support EU's digital strategy and sovereignty[6].

The study identified[7] that 'Under Horizon 2020 and Horizon Europe, EuroHPC JU has been particularly effective in establishing integrated world-class, demand-oriented hyper-connected supercomputing and data infrastructure[8] in the Union and providing European researchers, industry, and the public sector access to its supercomputers'. Since its in 2017, EuroHPC has

[1] European Commission: Directorate-General for Research and Innovation, Shirinzadeh, S., Viscido, S., Endo, C., Lotito, A. et al., Horizon Europe and the digital & industrial transition – Interim evaluation support study – Phase 2 – Horizon Europe – Institutionalised partnership report – EuroHPC joint undertaking, Viscido, S.(editor), Lotito, A.(editor), Boekholt, P.(editor) and Lebhardt, F.(editor), Publications Office of the European Union, 2024, https://data.europa.eu/doi/10.2777/561873.
[2] (Chapter 4.4. Effectiveness of the ongoing Partnership Impact Assessment).
[3] (Chapter 4.4. Effectiveness of the ongoing Partnership Impact Assessment), page 29.
[4] The EuroHPC's mission is to develop, deploy, extend and maintain in the EU a world-leading federated, secure and hyper-connected supercomputing, quantum computing, service and data infrastructure ecosystem. Its purpose is to support the development and uptake of demand-oriented and user-driven innovative and competitive supercomputing systems based on a supply chain that will ensure components, technologies and knowledge limiting the risk of disruptions and the development of a wide range of applications optimised for these systems; and, to widen the use of that supercomputing infrastructure to a large number of public and private users, and support the twin transition and the development of key skills for European science and industry.
[5] Our supercomputers - EuroHPC JU (europa.eu)
[6] High Performance Computing | Shaping Europe's digital future (europa.eu)
[7] (Chapter 4.4. Effectiveness of the ongoing Partnership Impact Assessment).
[8] Integrated as all the systems are integrally part of the common infrastructure, world-class and state-of-the-art as it features leading-class computing capabilities with latest available hardware and software, demand-oriented as systems respond to user demands, hyperconnected as they enjoy high-speed bandwidth.

seen the multiplication of its total computing power by a factor of almost 16[9]. In addition, the increase of its share in the global supercomputing capacity has also risen from 12% to 20.8%[10] today in the top 500 world supercomputers. Today, three EuroHPC systems rank[11] in the top 10 world supercomputers, and EuroHPC makes its computing resources available to a wide range of scientific, industrial and public users all across the EU.

The procurement of these systems has also supported the digital strategic autonomy objectives and in particular in High Performance Computing (HPC) and Quantum Computing, in line with the EU's objective to make the best use of public procurement as a tool to stimulate innovation, support European industry and ensure the security supply chains in critical technology sectors. A European approach (upheld by a judgement of the European General Court)[12] has been a key aspect of the EuroHPC procurement strategy[13], setting a precedent and standard for future procurements, focusing on the inclusion of the' EU added value' criterion and the security and diversity of the supply chain.

On technologies, the interim evaluation study identified[14] that 'most of the JU's support to R&I activities is still ongoing only a few years after the JU established its legal autonomy from the EC, and therefore, it is still too early for evaluation of the impact of the funded projects'. However, EuroHPC is already actively contributing to the EU's strategic digital sovereignty and autonomy with R&I Calls and a specific example of outstanding result: the Rhea microprocessor, coming from the **European Processor Initiative (EPI)**[15], is powering the first exascale[16] supercomputer in Europe (JUPITER)[17] that has already been procured and in the process of installation, and the results of the DEEP[18] series of projects (H2020/HE) have provided the modular software technology to be used in JUPITER.

EuroHPC has also delivered on supporting the development of technologies and applications to strengthen the European High Performance Computing supply chain and promoting their integration in supercomputing systems that address many scientific, societal, environmental and industrial needs. EuroHPC supercomputers power hundreds[19] of scientific and industrial

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[9] Ratio of the total computing power (in Petaflops) in the European Union between 2017 and 2024–excluding the UK-, source Top 500 systems top500.org/lists/.

[10] Lists | TOP500, adding the total computing power of all EU Members in years 2017 vs 2024.

[11] **Lumi** in Finland, **Leonardo** in Italy and **MareNostrum 5** in Spain. 5 more EuroHPC petascale supercomputers are ranked in the world top 500 systems: Meluxina (LUX), Karolina (CZ), Discoverer (BG), Vega (SLO) and Deucalion (PT).

[12] Judgment of the General Court of 19 October 2022 – Lenovo Global Technology Belgium v Joint Undertaking EuroHPC CURIA - Documents (europa.eu).

[13] As prominently featured in the first call for tenders under HPC SMART 2019/1084 EU Funding & Tenders Portal (europa.eu).

[14] From the Executive summary on Effectiveness in the external support study.

[15] Home - European Processor Initiative (european-processor-initiative.eu)

[16] Exascale performance is the capability to perform more than 10 to the power of 18 floating point calculations per second. a computing power equivalent to around 3 million laptops Only a very few number of supercomputers in the world work at this scale.

[17] EPI_Jupiter_November.pdf (european-processor-initiative.eu)

[18] Projects – DEEP-Projects

[19] As an approximate number, NVIDIA (the GPU vendor with a 98% of the HPC accelerators market) estimated at the end of 2020 in 1800 the number of HPC applications running in the most powerful world supercomputers (EuropHPC Enters AI Era in Supercomputing | NVIDIA Blogs).

applications that impact and improve the daily lives of European citizens, such as weather forecasting and climate change, drug discovery, renewable energies, cybersecurity, and crisis prevention and management[20]. For example, EuroHPC supercomputers support the EU Destination Earth initiative[21] that aims to develop a highly accurate digital twin of the Earth on a global scale, making it possible to monitor, simulate and predict the interaction between natural phenomena and human activities. Another example is the Human Brain project[22] that has established the technical foundation for a new model of ICT-based brain research, driving integration between data and knowledge from different disciplines. This has inspired a whole new interdisciplinary approach in supercomputing-based research that is leading for example to the European Virtual Human Twins Initiative[23], an EU framework supporting the emergence and adoption of the next generation of solutions in healthcare including personalised medicine, targeted prevention, tailored clinical pathways, and to supporting healthcare professionals in virtual environments.

In this context, 15 Centres of Excellence[24] have been established to maintain European World leadership in key HPC applications addressing global challenges such as personalised medicine, materials and medicines, and energy. All these elements contribute to achieving the EU's objectives and policies, and plays a role in tackling global challenges, including the Sustainable Development Goals and the Paris Agreement on Climate Change.

The study points[25] out that '…the JU's activities in increasing expertise in application development and HPC competencies by means of HPC Applications Centres of Excellences (CoEs) and National HPC Competence Centres (NCCs) are also valuable for technology uptake, competence building and community establishment.' The EuroHPC is delivering in widening the use of supercomputing services and the development of key skills that the European science and industry need. This is happening through the establishment of 33 National HPC Competence Centres in the participating states[26] to broaden the use of HPC, providing HPC services to industry (and in particular SMEs) to facilitate and promote the transition to wider adoption of HPC. Before EuroHPC, there was no single-entry point (and in most of the Member States, there was no entry point at all) for local actors, in particular for SMEs to receive in their own language information, support, and facilitation to HPC resources. The goal to establish the NCCs as the central points of contact towards the broad landscape of HPC has been achieved within the EuroHPC ecosystem, with the target groups

[20] Source: Section 3.1 and Annex III of 18.9.2020 SWD(2020) 179 final - COMMISSION STAFF WORKING DOCUMENT 'Equipping Europe for world-class High Performance Computing in the next decade' - Accompanying the document 'Proposal for a Council Regulation on Establishing the European High Performance Computing Joint Undertaking' COM(2020) 569 final.
[21] Destination Earth | Shaping Europe's digital future (europa.eu)
[22] Human Brain Project
[23] European Virtual Human Twins Initiative | Shaping Europe's digital future (europa.eu) - Virtual Human Twins: Launch of the European Virtual Human Twins Initiative | Shaping Europe's digital future (europa.eu).
[24] EU HPC Centres of Excellence (hpccoe.eu)
[25] From the executive summary on effectiveness in the external support study.
[26] EuroCC - EuroHPC JU (europa.eu)

perceiving the NCCs as competent and experienced contacts towards different HPC actors in their countries and across Europe[27].

EuroHPC supports a wide range of digital skills, professional training and education activities to increase the skills and knowledge of the European workforce, such as the European Master in HPC[28], the EuroHPC Virtual Training Academy[29], or the EuroHPC Training Platform and support to the International HPC Summer School[30]. In addition, all HPC Centres of Excellence perform training activities in the computational research disciplines in their respective area. EuroHPC supercomputers have advanced AI capacities to cope with the new demands of AI-powered applications that emerged recently, in particular Generative AI (GenAI) foundation models. Two factors support the contribution of EuroHPC to boost European leadership in trustworthy AI, in particular start-ups. Firstly, the new amended EuroHPC Regulation[31], adopted in July 2024, which supports the announcement of European Commission President von der Leyen in 2023 and the Commission's aim of putting '**generative AI made in Europe**' on the map, and specifically reflected in the call establishing the EuroHPC **AI Factories**[32]. Secondly, the opening of existing EuroHPC supercomputers[33] to innovative European AI startups with specific access calls[34] to train their trustworthy AI models and therefore strengthening the AI ecosystem to prepare for the future AI Factories.

What is the assessment of the **long-term** scientific, societal, economic and technological impacts of this partnership for the period under evaluation (in Horizon 2020 and in Horizon Europe)? **3 pages**

The study identifies[35] that 'it is, however, expected that these (R&I) activities will improve Europe's scientific excellence in the HPC area and result in HPC hardware and software, which, in the long term, could contribute to a more robust European supply chain and enhanced technology autonomy.' The activities already launched by EuroHPC will have a lasting long-term impact on the scientific, societal, economic and technology aspects, with an integrated view that closes the chain from R&D to the delivery and operation of HPC systems and contributes to both the improvement of Europe's scientific excellence in the HPC area (hardware, software and applications), the European critical technology autonomy and the robustness of the European supply chain.

The mid and long-term goal is to integrate the competitive technology (hardware and software) that has been developed in the EU into future EuroHPC supercomputers, and in particular technology resulting from the EuroHPC R&I calls.

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[27] Reporting – EuroCC ACCESS (eurocc-access.eu) Deliverables D4.2 and D5.5 of CASTIEL.
[28] Home - EUMaster4HPC Master website
[29] EuroHPC Virtual Training Academy - EuroHPC JU (europa.eu)
[30] EuroHPC Training Platform and support to the International HPC Summer School (europa.eu)
[31] The 'AI Factories' Amendment to the EuroHPC JU Regulation Enters Into Force - EuroHPC JU (europa.eu)
[32] EU boosts European AI developers with the AI Factories call for proposals | Shaping Europe's digital future (europa.eu)
[33] Commission opens access to EU supercomputers to speed up AI (europa.eu)
[34] Access calls for AI training EuroHPC JU Access Call for AI and Data-Intensive Applications - EuroHPC JU (europa.eu).
[35] From the executive summary on effectiveness in the external support study.

EuroHPC's R&I activities support a highly competitive and innovative supercomputing and data ecosystem contributing to the scientific and digital leadership of the EU, capable of autonomously producing computing technologies and architectures and their integration on leading computing systems, and advanced applications optimised for these systems. EuroHPC is actively contributing to the EU's strategic digital sovereignty and autonomy. It is doing this through the creation of a full European and autonomous HPC technology ecosystem, which is vital to remedying the current situation of total dependency on US high end processors. The main European R&I initiatives for HPC-suitable processors are supported by EuroHPC so far are the following: the **European Processor Initiative (EPI)**[36], and the **DARE Framework Programme Agreement for RISC-V**[37], supporting the design in Europe of high-end processors based on the open RISC-V standard, which will provide the first independent source of high-end processors (including AI specific accelerators), mitigating our current total dependency on US.

The EPI and DARE initiatives will have a mid- and long-term impact on sovereignty. The most immediate impact is in the first supercomputer in Europe (JUPITER)[38] to reach the frontier of the most powerful supercomputers of the world, the exascale computing[39]. The selected integrator of JUPITER is an EU vendor (ATOS/EVIDEN) and one of its critical computing partitions will be powered by a high-end processor (RHEA) resulting from the European Processor Initiative (EPI) and developed by a European company (Sipearl). It is expected that this trend will be increased in the second European exascale (**Alice Recoque)**[40] already in the pipeline for procurement. Regarding DARE, it will provide general purpose and accelerator processors (including specific accelerators for AI) and integrate them in future European supercomputers, with technology based on open RISC-V, **guaranteeing that the IP generated is fully European and ensuring technological independence from third countries licensing and restriction schemes**. These technologies will not only have an impact on high end computing, as the innovative chiplet designs are expected to have a direct impact on processors used for other sectors and applications such as data servers, cloud technologies, automotive, and more, and DARE complements the efforts on RISC-V developments carried by the Chips JU[41] (e.g. Tristan[42] and Isolde[43] projects).

In addition, EuroHPC continues to improve the existing world-class supercomputing and data infrastructure, with two exascale supercomputers (installation of JUPITER[44] and the ongoing

[36] Home - European Processor Initiative (european-processor-initiative.eu)
[37] Framework Partnership Agreement (FPA) for developing a large-scale European initiative for High Performance Computing (HPC) ecosystem based on RISC-V - EuroHPC JU (europa.eu)
[38] Procurement contract for JUPITER, the first European exascale supercomputer, is signed - EuroHPC JU (europa.eu)
[39] 10 to the power of 18 floating point operations per second, a computing power equivalent to nearly 3 million laptops.
[40] Signature of the Hosting Agreement for the Second European Exascale Supercomputer, Alice Recoque - EuroHPC JU (europa.eu)
[41] Home · Chips Ju (europa.eu)
[42] TRISTAN – Expand, mature and industrialize the European RISC-V ecosystem (tristan-project.eu)
[43] ISOLDE | (isolde-project.eu)
[44] European Exascale Supercomputer JUPITER Sets New Energy Efficiency Standards with #1 Ranking in GREEN500 - EuroHPC JU (europa.eu)

procurement for Alice Recoque)[45], and the ongoing Calls for AI Factories, industrial-class systems and eight quantum systems[46]. The EuroHPC infrastructure will increase dramatically the overall computing capacity available in Europe in combination with AI capabilities, powering HPC/AI applications that already shape our societies. However, it **will even have a bigger fundamental impact on our daily lives**, leveraging applications across virtually all branches of science, industry and activity sectors that combine **supercomputing, big data and AI and represent key drivers of technological innovation and economic growth in the global data economy.**

- Personalised medicine, including implementation of digitalised clinical trials for medicines and devices, medical training, surgical intervention planning, medical virtual environments, organ simulations (e.g. Alya Red for the heart)[47] or human 'digital twins' for healthcare technologies and treatments adapted to individuals such as the Virtual Human Twins initiative supported by the Commission[48].
- Drug discovery design and testing, identifying effective drugs in a matter of days instead of months or years using supercomputing platform for simulation. For example, understanding and predicting proteins structures is one of the most complex problems with enormous scientific and commercial impact. HPC with AI and Big Data drastically reduce the time to simulate self-assembly and protein interactions processes, which can be used to predict and design safe new protein structures with desired properties. This is illustrated by the European Exscalate[49] platform, the most powerful and cost-efficient intelligent supercomputing platform in the world for drug repurposing and vaccine development.
- Advanced engineering processes and industrial competitiveness, simulating larger and finer details of systems (e.g. full aircraft simulation) used e.g. by Airbus[50], reduce the design and optimisation timeframes, and integrate complex data management and analytics workflows.
- Materials applications to simulate and describe the underlying properties of matter needed to optimise the design of new materials and energy technologies[51]. For example, QUANTUM Expresso for quantum materials modelling that pave the way for cleaner batteries, fusion energy, high performance photovoltaic materials, or optimising turbines for electricity production.

[45] New Call to Procure the European Exascale Supercomputer, Alice Recoque - EuroHPC JU (europa.eu)
[46] One step closer to European quantum computing: The EuroHPC JU signs hosting agreements for six quantum computers - EuroHPC JU (europa.eu) + two upcoming systems: New EuroHPC Quantum Computer to Be Hosted in the Netherlands - EuroHPC JU (europa.eu) and New EuroHPC Quantum Computer to Be Hosted in Luxembourg - EuroHPC JU (europa.eu).
[47] Alya Red: A computational heart | BSC-CNS
[48] Virtual Human Twins: Launch of the European Virtual Human Twins Initiative | Shaping Europe's digital future (europa.eu)
[49] Exscalate | AI Drug Discovery Platform, with a processing capacity of testing the binding of 16.5 billion molecules on a protein per hour using a chemical library of 2 trillion organic molecules.
[50] Microsoft PowerPoint - PRACEdays15_E.Chaput.pdf.pptx (prace-ri.eu)
[51] Codes | MaX (max-centre.eu)

- On climate, the EU Destination Earth initiative[52] supported by the Commission reinforces the capabilities of private and public actors to take decisions reducing the impact of human activities in the planet's ecosystem.
- Industrial competitiveness and SMEs, enabling companies to become more innovative and productive and to discover new business opportunities. A number of key applications are supported by the Excellerat Centre of Excellence, aiming at a low carbon, more environmentally friendly and socially responsible product development and manufacturing as well as the mobility and energy sector[53]. Cases where SMEs have successfully leveraged HPC technologies include optimising industrial CO_2 capture and utilisation, a digital twin for inhaled drug delivery in human airways and increasing forecasting reliability in manufacturing. The FF4EuroHPC[54] initiative helps facilitate access to all HPC-related technologies for SMEs and, as demonstrated by its success stories[55], has contributed to increase the innovation potential of European industry.

EuroHPC contributes this way to place the EU as a main world actor in AI. EuroHPC, through the AI Factories initiative that has been launched in 2024[56], is expected to also have a key long-term impact across the board in scientific, societal, economic and technological aspects. Supercomputing is the motor that powers the ongoing 'renaissance' of AI, in particular Generative AI (GenAI) foundation models[57]. The impact of Generative AI is affecting the way to do science and reverberates across industries from the streamlining of production processes to the revolutionising of marketing strategies. Generative AI drives scientific and technological innovation, enhances productivity, and helps business gain a competitive edge.

2. Additionality

The EuroHPC JU mobilises various financial resources. In addition to the contribution by participating countries and private partners, the EU's contribution is made through different funding programmes (H2020 and Connecting Europe Facility (CEF) -1 for 2018-2020, HE, CEF-2 and Digital Europe programme (DEP) for 2021-2027).

For EuroHPC, and according to Regulation2018/1488, for the previous multiannual financial framework (MFF) the total Commission's contribution was up to 525 million EUR, of which 425 million EUR came from H2020 (with 241 million EUR for procurement and associated operational costs), and 100 million EUR from CEF (procurement and operational costs). The participating states made contributions commensurate to that of the EU, reaching 538 million EUR (incl. 10 million EUR for operational costs). For the current MFF and according to

[52] Destination Earth (destination-earth.eu)
[53] Excellerat (hpccoe.eu)
[54] Fortissimo Plus (ffplus-project.eu)
[55] Success stories (ff4eurohpc.eu)
[56] EU boosts European AI developers (europa.eu) and The EuroHPC Joint Undertaking Launches AI Factories Calls to Boost European Leadership in Trustworthy AI - EuroHPC JU (europa.eu).
[57] Commission opens access to EU supercomputers to speed up artificial intelligence development | Shaping Europe's digital future (europa.eu)

Regulation 2021/1173, the total EC contribution for the years from 2021 to 2023 is up to 1.362 million EUR, distributed between the Digital Europe programme (897 billion EUR), Horizon Europe (365 million EUR) and the Connecting Europe Facility 2 (CEF-2) (100 million EUR),

Until to the end of 2023, estimated in-kind financial contributions from participating states amount to 52 million EUR (rounded) under H2020/CEF1, while from private members they amount up to 18.5 million EUR (rounded).

The JU also contributes to the creation and expansion of the R&I network through the programmes initiated by the JU such as HPC Centres of Excellence (CoEs) and HPC National Competence Centres (NCCs). The JU organises communication and project activities and ensures that JU's private members have access to a wide range of stakeholders from research, industry, and public bodies in HPC, as well as related topics, data, and quantum technologies.

The partnership leverage factor for mobilising private resources is low because in EuroHPC the Digital Europe Programme funding for the acquisition of public infrastructures (which represents a big percentage of the EuroHPC budget) has been taken into account to calculate this factor.

The EuroHPC also provides a way to combine private funding with DEP for the acquisition of industrial-grade systems, but these represent a very small percentage of investments compared to the public infrastructure funded by national and EU funding.

3. Transparency and openness

The study identifies[58] that 'EuroHPC JU has measures to attract new infrastructure users and project participants. Private members play an important role due to their activities and broad membership consisting of academic and industry entities. CoEs and NCCs are other effective tools for networking and attracting newcomers from research and industry.' Transparency and openness take place at different levels[59].

At the level of public members, all EU Member States and non-EU countries associated to Horizon Europe or the Digital Europe programme can apply to become members of the JU in the conditions set up in the EuroHPC Regulation. Currently the public participants are the EU (represented by the Commission) and 35 participating states[60].

The EuroHPC has shown its capacity to open to new communities with the introduction of the quantum-related objectives in the Regulation (EU) 2021/1173. A new private partner joined the JU representing the quantum community, the European Quantum Industry Consortium

[58] From the Executive summary on Transparency and Openness in the external support study.
[59] Chapter 4.9 Transparency and Openness in the external support study.
[60] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, Malta, Montenegro, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Türkiye and United Kingdom.

(QUIC)[61], and new quantum stakeholders have successfully joined the activities and bodies of the JU.

EuroHPC is open to new private members established in the EU Member States. The current private members include the European Technology Platform for High-Performance Computing (ETP4HPC)[62], the Big Data Value Association (BDVA)[63], and the European Quantum Industry Consortium (QUIC)[64]. They cover most of the relevant stakeholders in their respective domains addressing important technologies directly related or tightly correlated with the European HPC ecosystem such as supercomputing, big data and quantum technologies. These private members are open to new partners active in related technology areas according to their membership policies.

EuroHPC calls are open and not restricted to project partners that are members of any of the private members.

Regarding the use and access to EuroHPC supercomputers[65], researchers from academia, research institutes, public authorities, and industry can apply for access to computing time on EuroHPC supercomputers, if they meet the eligibility requirements indicated by the Access Policy[66]. In this sense, EuroHPC is an open and transparent instrument that supports all participants in Horizon Europe activities that can benefit from HPC capabilities.

Specific support for industry, and in particular European SMEs and startups, is one of the key goals of EuroHPC. The JU has mechanisms to increase SMEs participation such as specific calls[67] supporting competitiveness and innovation potential of SMEs, with specific initiatives such as FF4EuroHPC[68] to facilitate access to all HPC-related technologies for SMEs and special access to the supercomputers without fees for innovation activities and other tailored mechanisms to facilitate SME use of the HPC infrastructure[69].

Although there has been a slight decrease[70] in the share of SMEs participation in HE compared in H2020 (10.2% vs 14.3% respectively), the total Commission's contribution, the share of this contribution and the average Commission's contribution to SMEs have increased (2.4 million EUR to 10.9 million EUR, 7.0% to 7.7% and 187.1k EUR to 185.7k EUR respectively), and the share of SMEs participation in the EuroHPC calls has been higher than that of large companies from 2020 to 2022.

[61] Homepage - QuIC (euroquic.org)
[62] Home | etp4hpc
[63] Big Data Value Association - Accelerating data-driven innovation in Europe ↗ (bdva.eu)
[64] Homepage - QuIC (euroquic.org)
[65] Access Policy and FAQ - EuroHPC JU (europa.eu)
[66] 30614065-6dd6-4206-8065-fc97948e5e2c_en (europa.eu) - Access Policy of the EuroHPC JU supercomputers.
[67] Supporting competitiveness and innovation potential of SMEs - EuroHPC JU (europa.eu)
[68] Fortissimo Plus (ffplus-project.eu)
[69] EuroHPC Access policy, Chapter 3.1.2 30614065-6dd6-4206-8065-fc97948e5e2c_en (europa.eu).
[70] Table 7 on Section 4.9.3 in the external support study.

EuroHPC JU private members are open and very active to increase SME participation and offer various membership statuses for reasonable fees with additional discounts for SMEs, namely EPT4HPC[71],BDVA[72] and the European Quantum Industry Consortium (QUIC)[73].

The partnership can be expanded by a decision of the Governing Board that assesses the applications of new public or private members. The Board needs to take into account the relevance and the potential added value of the applicant in terms of achieving the mission and objectives of the JU as set out in the EuroHPC Regulation.

At project level, the calls for R&I are open, and not restricted to project partners that are members of any of the private members. Projects and framework programme agreements supported by EuroHPC are open to changes in membership according to the grant agreement rules.

The private members associations are open to new members according to their respective statutes.

Most beneficiaries of EuroHPC calls have already participated under H2020[74], but the JU aims to expand and enlarge the communities and has specific measures to attract new potential participants to future R&I Calls and to new infrastructure users.

- The annual EuroHPC open event (EuroHPC Summits)[75] gathers the HPC community at large (technology providers, academics/researchers, users, etc.) in which the ongoing and future calls are publicised.
- The three private members also play an important and active role to attract new participants to EuroHPC. Private members have a broad representation of academic and industry organisations and have open information events to present project results and inform of new EuroHPC activities.
- HPC Centres of Excellence (CoEs) and National Contact Points of HPC (NCCs) are also powerful tools to enable networking and attract newcomers form research and industry. CoEs have an active role in expanding and reaching out to new partners in their respective scientific areas, in particular those without HPC expertise. The NCCs is an initiative designed for empowering national and local communities in HPC, in particular SMEs, that can enjoy of a local first contact and entry point in their own country. Also, the EuroHPC has added new beneficiaries in particular in the quantum fields.

The process for consulting relevant stakeholders is described in the EuroHPC Regulation, with two bodies (the Research and Innovation Advisory Group (RIAG[76]) and the Infrastructure Advisory Group (INFRAG[77])) that provide advice to the Governing Board to

[71] Our members – ETP4HPC
[72] Become a BDVA member - BDV Big Data Value Association
[73] Membership - QuIC (euroquic.org)
[74] Section 4.9.1 in the external support study.
[75] EuroHPC Summit 2024- Antwerp -.
[76] Research & Innovation Advisory Group (RIAG) - EuroHPC JU (europa.eu)
[77] Infrastructure Advisory Group (INFRAG) - EuroHPC JU (europa.eu)

draft the EuroHPC multiannual strategic programme identifying the R&I priorities and the planning of the infrastructures acquisition, and user needs.

Both RIAG and INFRAG organise public consultations open to all public and private stakeholders interested in HPC and quantum computing and also involves the private members (in particular regarding their strategic research agendas).

The EuroHPC Summit events[78] are open and feature a wide range of specific information sessions, workshops and plenary discussions etc. in which participants can talk directly with the members of all the JU bodies [79].

The largest EuroHPC flagship R&D initiatives (EPI and DARE) were preceded by several preparatory open workshops and consultations with the interested stakeholders providing bottom-up input.

Participating states are also actively involved in identifying priorities[80] as they provide financial support to the EuroHPC activities.

The EuroHPC Castiel and EuroCC[81] initiatives also involve stakeholders and raise the awareness of the HPC Centres of Excellence and National Centres of Competence activities, such as outreach activities to create links between EU and non-EU countries not currently in the partnership, measures to strengthen participation (particularly SMEs), target visits to less-represented stakeholder, public consultations, open dialogues, city panels, webinars to engage end-users, regular open brokerage/networking events etc.

Many projects are still ongoing and the JU still needs to evaluate the dissemination output and publication results. There are however measures for informing on the R&I activities' results such as annual conferences and project reviews, and in particular, at the annual EuroHPC Summits.

On the points to improve, the webpage of the EuroHPC JU could benefit from a better design and functions, including a user-friendly interface to present past results and retrieve/collect/analyse data from the EuroHPC projects and initiatives.

4. Efficiency

The table below includes the total **operational costs** (EU contributions; Validated IKOP; Financial contributions to operational activities by JU partners; Eligible project costs funded by non-JU members to project activities; Contribution from Member States and international organizations to project activities) and **running costs** (commitment appropriations EU voted budget and contributions from sources other than the EU) for the period 2014-2023. EuroHPC

[78] EuroHPC Summit 2024- Antwerp -.
[79] the EuroHPC Executive Director and staff, Governing Board, and the EuroHPC JU Advisory Groups INFRAG and RIAG, plus the Participating States and the Commission.
[80] The EuroHPC Executive Director organises with the Governing Board chair a series of preparatory workshops previous to the discussion and voting of the workprogrammes.
[81] The Projects – EuroCC ACCESS (eurocc-access.eu)

does not have IKAA. See also Annex 4.4.1 for a comparison of operational expenditure and administrative expenditure of Joint Undertakings and EIT KICs of the period 2014 -2023.

Operational and administrative expenditures of EuroHPC JU (source: CORDA)

*The table includes data for EuroHPC Joint Undertaking. **OC**: Operational Costs; **IKAA**: Certified IKAA; **RC**: Running Costs*

	2014 [EUR]	2015 [EUR]	2016 [EUR]	2017 [EUR]	2018 [EUR]	2019 [EUR]	2020 [EUR]	2021 [EUR]	2022 [EUR]	2023 [EUR]	Total
OC	-	-	-	-	-	10,378,125	165,022,968	105,771,724	76,822,758	16,995,687	374,991,262
IKAA	-	-	-	-	-	-	-	-	-	-	-
RC	-	-	-	-	-	376,560	3,110,859	3,080,263	3,041,309	4,274,899	13,883,890

The study states[82] that 'The R&D funding under the Horizon Europe seems to be very efficient. The average time to inform the evaluation results, to sign and to grant in HE was shorter than in H2020. The call budget is adequate in terms of its alignment with stakeholder needs, as indicated by the high success rate for high quality proposals (higher in Horizon Europe than in Horizon 2020).'

However, here there is room for improvement, as in some strategic technologic initiatives (e.g. DARE) a short time to grant is critical and the EuroHPC should reduce the current average times to inform the evaluation results (TTI). In particular, the time to grant (TTG) much below the reported 250.7 days, which is clearly very high in a very fast-moving field of HPC technologies. In this sense, the co-funding scheme with EU Member States introduces long delays as in many cases partners must go through time-consuming national administrative procedures which negatively affect the start of projects.

5. Coherence and synergies

EuroHPC is a unique mechanism as it combines the funding of Horizon Europe, Digital Europe programme and the Connecting Europe Facility to support the EuroHPC's seven pillars of activity. These pillars of activity cover a wide range of activities supporting the whole HPC ecosystem, including technological R&D (in all the steps from research to integration in pilots and demonstrators), the procurement of infrastructures and the provision of a wide range of user services, application development and dissemination, take-up, training, user support, etc. It is obvious that EuroHPC offers a single umbrella at EU level for such a variety of activities. Therefore, the synergy of the different programmes is fully exploited.

EuroHPC also fosters in its Regulation the complementarity of these programmes with other policies and programmes by promoting synergies with the European Regional Development Fund (ERDF), the European Social Fund+ (ESF+), the European Maritime, Fisheries and Aquaculture Fund (EMFAF) and the European Agricultural Fund for Rural Development (EAFRD), as well as the Recovery and Resilience Facility (RRF).

[82] Section 4.3.1 under the Chapter 4 'Efficiency'.

EuroHPC provides a legal framework for participating states that are EU Member States to use the financial contributions under the programmes co-financed by ERDF, ESF+, EMFAF and EAFRD to acquire HPC and quantum computing and data infrastructures and their interconnection. The use of those financial contributions in the JU activities is essential in achieving the EuroHPC's objectives. It also benefits both the EU's objectives as well as those from its Member States, providing them with world-class infrastructures using a wide range of additional funds. Regarding the RRF, several EU Member States mentioned, in their national plan, their intention to use RRF to acquire this infrastructure, as stated in the Commission's notice Guidance on the recovery and resilience plan[83]: 'Member States have used the RRF strategically to advance their reform and investment agendas, in line with common EU priorities, and tackle both long-standing and new challenges…'. However, a lack of clarity and legal reliability from the Commission about the use of RRF as co-funding in EuroHPC by several Member States (IT, HE, ES, and other countries) before the publication of this guidance on the recovery and resilience plan, caused uncertainty that lasted for almost two years. It was very difficult to align this instrument with JU actions and meet the RRF implementation deadlines. This is a clear case of room for improvement.

A better matching and alignment of the activities proposed by EuroHPC with the Commission priorities remains another point for improvement. The process to develop and discus the different work programme topics and future orientations by the Governing Board is still not well defined and needs to be improved with a better upstream dialogue with Commission departments and avoid time delays in approving and launching initiatives.

EuroHPC activities are aligned with other major initiatives such as the Chips JU. The EuroHPC Framework Programme Agreement (DARE) for developing a large-scale European initiative for HPC ecosystem based on RISC-V was called specifically[84] to be aligned and complement the activities to be carried out by the KDT/Chips JU[85] and to leverage and contribute to the common work to establish a rich RISC-V ecosystem in Europe, with DARE concentrating on the high-end processors. Whereas, the KDT/Chips JU develops vertical sectors with less demanding processors and address the horizontal foundational activities underpinning the development of the full RISC-V ecosystem in Europe.

A major outcome of the EuroHPC European project initiative (EPI) is the design of the general-purpose microprocessor powering the JUPITER supercomputer by the Sipearl company. SiPearl received[86] 17.5 million EUR from EIC (2.5 million EUR grant and up to 15 million EUR in equity investments subscribed by EIC Fund) to support the development and scale-up of the SiPearl future-generation microprocessor.

EuroHPC is in the process of awarding the Federation Call[87] to ensure the interconnection of the federated, secure supercomputing, and quantum computing service and data infrastructures with the common European data spaces, including the European Open Science

[83] Commission Notice – Guidance on recovery and resilience plans (europa.eu)
[84] Decision 35_2022_launch call for establishing FPA (RISC V)_.pdf (europa.eu)
[85] Home · Chips Ju (europa.eu)
[86] SiPearl: 1st investment by EIC Fund - SiPearl
[87] EuroHPC Federation Platform - EuroHPC JU (europa.eu)

Cloud, and federated, secure cloud infrastructures announced in the Communication from the Commission of 19 February 2020 entitled 'A European Strategy for Data'[88], for seamless service provisioning to a wide range of public and private users across Europe.

A better structured dialogue with the Chips JU and the Commission in order to better align the objectives of the different initiatives supported by the two partnerships remains an area for improvement.

6. EU added value

The EuroHPC has been the instrument at EU level to coordinate and leverage national programmes in HPC. Before EuroHPC, there were 27 different supercomputing programmes in Europe and no European supercomputers. With the creation of EuroHPC, the EU has gained a prominent position as a world power in supercomputing with European systems that can be accessed by academic, industrial or public users no matter where they are in Europe, and the Member States policies have a guiding European initiative that helps to plan their own HPC policies and strategies.

However, a point for improvement remains the commitment of national funding to the EuroHPC activities, as EU Member States have made limited use of the central management of financial contributions (CMFC). EU Member States also have different budgetary planning schedules and even some national priorities (or even negative priorities) that influence the allocation or not of national funds to participants in EuroHPC project. Delays in the national budgetary commitments and negative national priorities diminish the effect of initiatives with EU scope and impact.

The EuroHPC's financial structure enables participating states to acquire or participate in the acquisition of very large supercomputers by pooling of EU and national resources and the provision of the required infrastructure all over Europe. This is not possible for EU Member States to do alone. This applies to both EU Member States with limited budget and with stronger financial resources for HPC. EuroHPC allows for the acquisition of world-class systems that otherwise they would not been able to afford on their own, with the possibility of leveraging the funds from different participating states to buy a more powerful system that is used for national priorities. In this sense, EuroHPC may be considered as a leverage solution providing an optimal EU added value.

The EuroHPC JU has been an effective tool compared to national and regional initiatives, as the JU provides a strong single coordinating initiative. Before EuroHPC, Member States' and the EU's investments in HPC remained largely uncoordinated. As compared with competitors in the US, China[89] and Japan, the EU and its Member States were clearly underinvesting in HPC with a funding gap of 500-750 million EUR per year[90]. This gap has been reduced

[88] Data | Shaping Europe's digital future (europa.eu)
[89] Note that China is not reporting in 2024 the totality of its computing capacity.
[90] 'Financing the future of supercomputing: How to increase the investments in high performance computing in Europe', EIB 2017, https://www.eib.org/en/publications/financing-the-future-of-supercomputing and SWD(2018) 6 final - Impact assessment accompanying the 'Proposal for a Council Regulation on establishing

overall with Japan, and in terms of number of systems but not in the total computing power[91] with respect to the US, as shown in the following table[92].

	2017			2024		
	Top500 Systems	**Top500 Pflops**	**Ratio of computing**	**Top500 Systems**	**Top500 Pflops**	**Ratio of computing**
EU	71	163.12	-	130	2600.68	-
US	143	391.61	2.40	171	6968.77	2.68
CN	202	524.58	3.22	80	627.66	0.24
JP	35	136.44	0.84	29	888.12	0.34

Under H2020 and HE, the EuroHPC JU has been the major tool above the mainstream FP to pursue the EU's strategies and objectives in HPC, coordinating all related financial, legal and R&I aspects. In particular, the JU has provided added value in establishing procurement mechanisms, providing access to HPC systems for stakeholders, and addressing their needs through various tools such as CoEs and NCCs. This is particularly important for the technology development of high-end processors carried out by the EuroHPC Framework Programme Agreements (FPA) such as the European Processor Initiative (EPI) and DARE. The amount of critical financial and know-how resources required do not exist in a single EU Member State, and the ambitiousness of the objectives cannot be achieved by uncoordinated calls.

The JU also contributes to the creation and expansion of the R&I network through the programmes initiated by the JU such as Centres of Excellence (CoEs) and National HPC Competence Centres (NCCs). In particular, Centres of Excellence gather European communities working in different computational research areas, building critical mass in the long term, maximising the use and sharing of R&I results, reducing duplication of efforts (e.g. generalising the use of optimal workflows for HPC simulations, sharing of programming environments and data sets, etc.) and creating synergies and convergence among the otherwise unconnected users of R&I projects. Centres of Excellence is a major innovation in the R&I landscape for research using the high-end computing and data resources. National Centres of Competence provide a single-entry point for HPC stakeholders at national level, while leveraging their networking and sharing of best practices, resources, etc., multiplying the effect that national activities could have on HPC.

In addition, one of the most important EuroHPC JU initiatives are the AI Factories launched in 2024[93], which support and complement the national AI ecosystems and contribute to the

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the EuroHPC Joint Undertaking', 5 Annex 2017 SWD_2018_0305_FIN.ENG.xhtml.2_EN_impact_assessment_part1_v4.docx (europa.eu).

[91] The ratio of computing is obtained by dividing the total Pflops available in other countries by the Pflops available in the Union.

[92] Lists | TOP500; the row EU indicates Member States in 2017 and EuroHPC + Member States in 2024.

[93] EU boosts European AI developers (europa.eu) and The EuroHPC Joint Undertaking Launches AI Factories Calls to Boost European Leadership in Trustworthy AI - EuroHPC JU (europa.eu).

implementation of both the AI and Data European and national AI strategies of the hosting country/countries of AI Factories.

7. Relevance

The strategic and operational objectives of the EuroHPC JU are well aligned with the H2020 and HE Framework objectives as they aim to strengthen the EU's global position in HPC field and increase its industrial competitiveness. The need to deploy in the EU a world-class HPC and quantum infrastructure with the best supercomputers in the world, as well as the development of an autonomous European HPC technology ecosystem that reduces the critical risk of dependence on foreign HPC supply chains (mainly from the USA and China) are still very relevant. EuroHPC is a key instrument for Europe to reduce the risk of being deprived of strategic technological know-how and access to state-of-the-art supercomputing and quantum infrastructures for scientific and industrial innovation and competitiveness.

The EuroHPC objectives also support the processing of data and information in the EU, which are particularly relevant for AI technologies. Without the EuroHPC infrastructure, European scientists and industry would be seeking access to top machines located outside the EU to process their data. This creates problems for data protection, including personal and sensitive data (e.g. commercial data or trade secrets), and the ownership of data, in particular for sensitive applications such as health.

EuroHPC has been swiftly adapting its objectives according to the market and policy needs since its creation in 2017. The objectives of the original Council Regulation of 2017 were amended in the new Regulation of 2021 and in the most recent amendment adopted by Council in June 2024. The shift in the JU mission and goals is observed in different aspects in line with the progress of the partnership activities and the EU's political priorities.

- Regulation 2018/1488 focuses on the establishment of a single instrument to integrate the three main pillars of the HPC ecosystem: world-class infrastructures, technological development supporting EU's digital sovereignty, and excellence in key HPC applications.
- Regulation (EU) 2021/1173 broadened the pillars of activities with increased funds and ambitions. For example, the incorporation of quantum technologies to complement HPC and the need to federate, interconnect with high-speed connectivity and provide new secure services in the hybrid HPC/Quantum infrastructure, establishing a one-stop shop access point for any supercomputing or data service managed by the JU, or the interconnection with the EU's common European data spaces.
- The amendment to Council Regulation (EU) 2024/1732 of 17 June 2024 reflected the need in providing European stakeholders with the best computing resources to exploit the new opportunities in science and industry offered by AI. This latest amendment focuses on boosting the systems' AI capabilities acquired by EuroHPC and in particular the support of EuroHPC to the European AI strategy by establishing AI Factories for trustworthy and ethical AI, and an AI-oriented

supercomputing service infrastructure to further develop the research and innovation capabilities, competences and skills of the AI ecosystem.

The JU's calls for proposals and procurements also followed the changing needs of the technological and infrastructure needs, by further amending the Multiannual Strategic plan in 2023.

8. Directionality

The JU's strategic vision is clearly linked to the different impact dimensions of the FP (global positioning, industrial competitiveness, sustainability goals, and human-centred development), thus demonstrating high directionality. To achieve the vision, the EuroHPC has adopted several pillars of action under the HE, and various actors are involved in the pillars of action. In terms of the progress in delivering the results, the JU has been particularly successful in using the financial and legal mechanisms available for procurements to equip Europe with several world-class supercomputers. Three pre-exascale systems ranked in the top world 10 and five mid-range supercomputers in the top 500 systems, with two more top-of-the-range exascale and five mid-range supercomputers in the pipeline, which have been either procured directly by the JU or in cooperation with the national hosting entities.

In particular, the EuroHPC has been using the competitive dialogue procedure for the procurements of the pre-exascale (Lumi, Leonardo and Mare Nostrum 5) and exascale (JUPITER and Alice Recoque) systems due to the high complexity and demanding requirements of these supercomputers. EuroHPC, EU Member States and their hosting entities, and technology vendors work together to fine tune extremely complex HPC specifications so that the EuroHPC could get the latest state-of-the-art technology available in a fast-changing technological environment at best value for money, while ensuring competition and a fair playing field. This has resulted (as compared with a simple open procedure) in successful procedures with better prices and technology thanks to the iterative and competitive nature of this procurement arrangement.

HPC is already having a fundamental impact on our daily lives, powering hundreds of applications across virtually all branches of science, industry and activity sectors. EuroHPC supercomputers support critical HPC applications that are at the core of major advances and innovations in the digital age where to out-compute is to out-compete. The combination of HPC, big data and AI is already today a key driver of technological innovation and economic growth in the global data economy. HPC is an essential tool to address major scientific and societal challenges, reducing significantly design and production cycles, minimising costs, increasing resource efficiency, and shortening and optimising decision processes for industries, and a key tool for national security and defence, e.g. in developing complex encryption technologies, tracking and responding to cyberattacks, deploying efficient forensics, or in nuclear simulations.

9. International positioning

The EuroHPC JU aims to boost Europe's global position on HPC. Therefore, the focus of the JU activities is mainly on Europe and the EU Member States and the other participating states. The regulation supports in an activity pillar the international cooperation in supercomputing to solve global scientific and societal challenges in line with the EU's external policy objectives and international commitments, international collaboration while promoting competitiveness of the European High Performance Computing supply and user ecosystem.

So far, EuroHPC has focused on international cooperation activities to support and implement the EU Digital Partnerships with like-minded countries like Japan or the Republic of Korea. With Japan, EuroHPC already supports an action in the priority HPC application domains identified in the partnership such as biomedical, material science, seismic/tsunami and/or weather and climate modelling. A similar collaboration with India, this time supporting geopolitical objectives and more specifically the EU-India cooperation agreement in HPC[94], has been established with a call[95] to cooperate in HPC applications of common interest and create solutions/use-cases jointly in the mutual areas of interest using HPC (Bioinformatics, Climate Change and natural Hazards). The agreement intends to promote R&I in HPC, facilitate collaboration and knowledge exchange between Indian and European HPC communities, and advance scientific, industrial, and innovation capabilities through HPC.

At the global level, EuroHPC has already approved a call to support the European stakeholders' active participation in two major initiatives mainly with US and Japan, the Trillion Parameter Consortium (TPC)[96]. The initiatives aim to create huge foundation models accelerating the development and use of Generative AI for world science and engineering, and the International Post-Exascale Project (InPex)[97] to address at global level the huge challenges associated to post-exascale supercomputing.

10. Phasing-out preparedness

According to Article 10.2.(c) and Annex III of the Council Regulation 2021/695 on Horizon Europe, Joint Undertakings should adopt 'exist-strategies and measures' for phasing out of the Horizon Europe Programme.

Therefore, all Joint Undertakings shall adopt a plan for the phasing-out of the partnership from Horizon Europe funding. The aim of the plan is to ensure a smooth continuation of the JUs' activities in the scenario of no funds available under the next Framework Programme. In this perspective, JUs are asked to perform an in-depth reflection on a phasing out strategy leading to a lesser dependence from the Union contribution.

[94] https://digital-strategy.ec.europa.eu/en/news/india-and-eu-sign-intent-cooperation-agreement-high-performance-computing-and-quantum-technologies
[95] New Call Supporting EU-India Cooperation - EuroHPC JU (europa.eu)
[96] TPC European Kick-Off Workshop - Trillion Parameter Consortium (TPC)
[97] Home - InPEx Science

For EuroHPC, the drafting of the phasing out plan is currently ongoing and it is planned to be finalised by end 2025. It should include concrete reflections on short- and long-term targets, strategic alignment and financial sustainability, as well as administrative and operational adaptations, which should allow the JU to proceed its activities in case of no Union funding under the next Framework Programme.