2021 ANNUAL ACTIVITY REPORT

In accordance with Article 19 of the Statutes of the EuroHPC JU Annexed to Council Regulation (EU) No 2018/1488, repealed by Council Regulation EU No 2021/1173 and with Article 20 of the Financial Rules of the EuroHPC JU.

The annual activity report will be made publicly available after its approval by the Governing Board.

EuroHPC
Joint Undertaking

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FACTSHEET

Name	European High Performance Computing Joint Undertaking
Objectives	The original mission (Council Regulation 2018/1488) of EuroHPC JU is to develop, deploy, extend and maintain an integrated world class supercomputing and data infrastructure in the Union and to develop and support a highly competitive and innovative High Performance Computing (HPC) ecosystem. Following the adoption of the new Council Regulation 2021/1173 in July 2021, the JU's objectives were updated and now reads as follows: • to contribute to the implementation of Regulation (EU) 2021/695 and in particular Article 3 thereof, to deliver scientific, economic, environmental, technological and societal impact from the Union's investments in research and innovation, so as to strengthen the scientific and technological bases of the Union, deliver on the Union strategic priorities and contribute to the realisation of Union objectives and policies, and to contribute to tackling global challenges, including the Sustainable Development Goals by following the principles of the United Nations Agenda 2030 and the Paris Agreement adopted under the United Nations Framework Convention on Climate Change; • to develop close cooperation and ensure coordination with other European Partnerships, including through joint calls, as well as to seek synergies with relevant activities and programmes at Union, national, and regional level, in particular with those supporting the deployment of innovative solutions, education and regional development, where relevant; • to develop, deploy, extend and maintain in the Union an integrated, demand-oriented and user-driven hyper-connected world-class supercomputing and data infrastructure; • to federate the hyper-connected supercomputing and data infrastructure and interconnect it with the European data spaces and cloud ecosystem for providing computing and data services to a wide range of public and private users in Europe; • to promote scientific excellence and support the uptake and systematic use of research and innovation results generated in the Union; • to further develop and support a highly competitive and innovative supercomputing and data ecosystem broadly distributed in Europe contributing to the scientific and digital leadership of the Union, capable of autonomously producing computing technologies and architectures and their integration on leading computing systems, and advanced applications optimised for these systems; • to widen the use of supercomputing services and the development of key skills that European science and industry need.

Founding Legal Act	Council Regulation (EU) 2018/1488 of 28 September 2018 establishing the EuroHPC Joint Undertaking. On 2 August 2021, the new Council Regulation (EU) 2021/1173 of 13 July 2021 on establishing the European High Performance Computing Joint Undertaking and repealing Regulation (EU) 2018/1488 came into force.
Executive Director	Anders Dam Jensen
Governing Board	Chair on 31 December 2021: Dr Herbert Zeisel, elected in October 2021. Members: one representative of the EU and each Participating States. See Annex 3
Other bodies	The Industrial and Scientific Advisory Board consists of the Research and Innovation Advisory Group (RIAG) and the Infrastructure Advisory Group (INFRAG)
Staff	15 full time employees including the Executive Director as of 31 December 2021. Staff recruitment initiated to fill the new posts provided in the new Council Regulation.
2021 Budget	The budget revenue of the EuroHPC JU amounted to EUR 207.5 million in 2021. The majority of the budget came from EU contributions which amounted to EUR 116,1 million.
Grants	In 2021, 8 grant agreements were signed and 22 projects launched.
HPC Infrastructure Procurement	The following systems are operational in 2021: • Vega, hosted by IZUM in Maribor, Slovenia is fully operational • MeluXina, hosted by LuxProvide in Bissen, Luxembourg is partially operational, due to ongoing delays in the global supply chain issues. • Discoverer, hosted by consortium Petascale Supercomputer Bulgaria in Sofia, Bulgaria is fully operational • Karolina, hosted by IT4Innovations in Ostrava, Czech Republic is fully operational • LUMI, hosted be CSC in Kajaani, Finland, is partially operational The following systems are underway: • Leonardo, hosted by CINECA in Bologna, Italy • Deucalion, that will be installed by MACC in Guimaraes, Portugal

	• MareNostrum 5, to be hosted by Barcelona Supercomputing Center in Spain.
RIAG Strategic Research and Inoovation Agenda	EuroHPC_RIAG_Strategic_Agenda_2019_0.pdf (europa.eu) No updates in 2021.
INFRAG Multiannual Strategic Agenda	Multiannual Strategic Agenda (europa.eu) No updates in 2021.
MASP Multiannual Strategic Plan	Decision 24_2021_ MASP 2021-2027.docx (europa.eu) The MASP was developed during 2021 and adopted by the Governing Board in September 2021.
Call and procurement implementation of HPC systems	The installations of 4 petascale supercomputers were completed and the systems were put into operation in 2021. These supercomputers are Vega, Karolina, MeluXina and Discoverer. One partition of the LUMI supercomputer, LUMI-C, was also completed and put into operation. The LUMI supercomputer installation will be fully operational with the addition of LUMI-G partition (the GPU-based part of the supercomputer) which is currently under installation and expected to go online in summer 2022. Installation of Leonardo and Deucalion is also ongoing, and the systems are expected to be completed in Q4 2022. The MareNostrum5 procurement was cancelled in May 2021. A new procurement was launched in December 2021.
Participation, including SMEs	Total number of beneficiaries in all 28 EuroHPC projects funded during the reporting period: 304 of which: % of SMEs: 21 % of private for profit/large companies: 16

FOREWORD

This is the second Annual Activity Report of the EuroHPC JU since its autonomy in September 2020.

2021 was the first full year of operation for the EuroHPC Joint Undertaking since its autonomy in September 2020. The JU launched new R&I projects in HPC skills and education, microprocessors and a broad range of applications supporting greener computing, computer-aided drug design or better understanding of diseases.

In just over one year of autonomy the JU has already achieved the procurement of seven supercomputers located across Europe, two of which have already been inaugurated: Vega in Slovenia and MeluXina in Luxembourg. The first allocation of computing time on EuroHPC machines to European scientific, industrial and public sector users took place in 2021. This year also saw the selection of the first wave of innovative projects that will run on EuroHPC supercomputers, which respond to the JU's objectives and will ensure European sovereignty and excellence in HPC.

It has been a year of significant milestones. 2021 started off with the JU announcing the first projects of the year, Ligate and Scalable, to support the development of European exascale systems as well as drug design in response to pandemics.

In February, a procurement contract for a new petascale system was signed, to be hosted in Portugal and named Deucalion.

In March, multiple new projects were announced: Across, Heroes, NextSim and Optima were launched to focus on the development of energy-efficient HPC software and further develop, adapt, and optimize HPC software for applications in the European industry, while exploiting synergies with existing solutions and open-source projects.

April 2021 was a key month for the EuropHPC JU. In April, Vega became the first of HPC's supercomputers to become fully operational and was inaugurated by the Slovenian Prime Minister and Executive President and Commission Margrethe Vestager. This crucial step allowed the EuroHPC JU to accept applications from European scientific, industrial and public sector users for access time to Vega's supercomputing power. The JU also launched thirteen R&I projects in April in key areas of the JU's R&I plans and responding to the broader goal of helping Europe to become globally competitive in the field of supercomputing.

May 2021 was another important month as the EuroHPC JU's Headquarters in Luxembourg s were inaugurated by Luxembourg Ministers Asselborn and Fayot and Commissioner Thierry Breton, marking a major milestone in the JU's history and giving the JU's activities offices and a Luxembourg home.

In June 2021, another EuroHPC supercomputers became operational, this time MeluXina in Luxembourg. Meluxina was inaugurated by the Grand Duke of Luxemburg and Xavier Bettel, Luxembourg's Prime Minister. The JU also received multiple awards from the June 2021 edition of the Green500 and Top500 lists. Both MeluXina and Karolina were cited on the Green500 list, ranked 1st and 7th greenest supercomputers in Europe respectively, and 4th and 15th globally. All 4 of the JU's supercomputers were placed on the Top500 list both at European and global level.

On 8th of August 2021 Council Regulation (EU) 2021/1173 of 13 July 2021 establishing the European High Performance Computing Joint Undertaking and repealing Regulation (EU) 2018/1488 came into force, giving the EuroHPC JU new responsibilities in innovation and deployment of exascale and mid-range high performance computers and quantum computing and in hyperconnectivity.

The new Governing Board was formed in October 2021 and elected Dr Herbert Zeisel as its Chair for 2 years. This Governing Board meeting was the only one that took place physically in 2021.

September marked the first full year of autonomy of the JU, which was an opportunity to look back and share all that had been achieved in such a short time and with such a small team. Autumn 2021 was busy implementing the new Regulation and continuing with legacy work initiated under the previous Regulation.

The Governing Board selected the consortium that will run the new pan-European HPC pilot Masters' programme. Led by the University of Luxembourg in partnership with 7 other European Universities, it is due to welcome the first cohort of students by September 2022.

In October 2021 a third supercomputer inauguration took place in Sofia with European Commissioner for Innovation, Research, Culture, Education and Youth, Mariya Gabriel, Bulgarian Minister of Education and Science Prof. Nikolay Denkov, deputy Minister of Economy Krassimir Kiryakov and Commissioner Gabriel to witness Discoverer becoming operational.

A new call for tender for the pre-exascale supercomputer MareNostrum 5 was launched in December 2021, to better respond to the changing requirements of supercomputers. The call will allow this pre-exascale system to be specifically tailored to strengthen European medical research through drug research, the development of vaccines, virus spread simulations, as well as artificial intelligence and big data processing applications, in response to the Covid-10 Pandemic. The machine will also support traditional HPC applications, such as climate research, engineering, material science and earth sciences.

December also marked the launch of the EuroHPC JU's first quantum computing initiative and welcomed a new private member – the European Quantum Industry Consortium (QuIC) representing the European quantum industrial community.

The EuroHPC JU has already demonstrated that it is the right legal and financial instrument to address the shortcomings of the European HPC landscape and encourage Member States and EU funds to be pooled together to create European value for the Union as whole. Indeed, coordination of the HPC strategies of the Union and the Member States has already led to:

- Pooling of resources and investments;
- Availability within the Union of a world-class HPC infrastructure addressing user needs and demands;
- A structured and focused research and innovation agenda aligned with the overall ambition of creating a world-class HPC ecosystem;
- Increasing the public funding for R&I actions in the area of HPC.

The success of the EuroHPC Joint Undertaking was only possible thanks to the relentless efforts, dedication, and hard work of my very small and dynamic team in the Joint Undertaking, the members of the Governing Board, the members of the advisory groups, and the ongoing and helpful support of the Commission.

EXECUTIVE SUMMARY

The EuroHPC Joint Undertaking was established on 28 September 2018 by Council regulation No 2018/1488, published in the Official Journal of the EU on 8 October 2018 and entered into force on 28 October 2018.

The Executive Director was appointed on 15 May 2020 and started in the post on 16 September 2020. The Governing Board confirmed autonomy of the EuroHPC JU on 23 September 2020 when it confirmed that all autonomy criteria were met.

In August 2021, Council Regulation 2018/1488 was repealed by Council Regulation 2021/1173 which established the new mission of the EuroHPC JU.

This Annual Activity Report of the EuroHPC JU reports on the first full year of activities since autonomy.

1. ACTIVITIES IN 2021

As **2021 was the first full year of operations as an autonomous body**, this report covers the ongoing activities of the Joint Undertaking and from August 2021, the new activities. 2021 can be divided into two parts:

The JU continued to implement launched procurements and calls under the Horizon 2020 and Connecting Europe Facility programmes

Under the new Regulation, the JU received new funding for the period 2021 – 2027 from the Horizon Europe Programme, the Digital Europe Programme and the Connecting Europe Facility II . The new Regulation also provided the JU with a strengthened Staff Establishment Plan.

Activities in 2021 focused on: ongoing setting up the new Joint Undertaking, delivering the objectives of the work plan 2021, recruitment and adapting to a new regulation halfway through the year.

2. ADMINISTRATION, FINANCE AND GOVERNANCE

2021 witnessed the end of the Horizon 2020 programme. This meant finalising all legacy Horizon 2020 calls and finalising recruitment. It also meant having to wait for the new regulation to launch new calls and hire new staff.

The first full year of autonomy has been pivotal for the JU. New governance structures were set up and the provisions under the new Regulation as well as the new funding programmes

(Horizon Europe, Digital Europe Programme and Connected Europe Facility) to be implemented.

2021 saw the **election of Dr Herbert Zeisel as chair of the new Governing Board** and 11 Governing Board meetings were held throughout 2021. New Participating States of the Governing Board joined such as Malta and others did not return such as Switzerland.

2021 saw the **expansion of the JU's team** to 15 staff members, although the JU is still lacking staff and at the end of 2021 is starting a new round of recruitment to hire new staff members in 2022.

The JU received its first European Court of Auditors (ECA) feedback on its budget and accounting 2020. For the most part this feedback was positive, with some places to grow and implement changes. The EuroHPC JU's first European Parliamentary discharge in respect of the implementation of the JU's budget for 2020 was granted and adopted by the European Parliament in May 2022.

For 2021 account and budget, the ECA has raised one issue, common to all Joint Undertakings, regarding the calculation of employer pensions contribution of JU staff. EuroHPC JU will resolve this with DG BUDG in the European Commission in 2022.

Furthermore, in 2021 DG BUDG wrote to all JUs to announce that it no longer wished to provide Accountant services for the JUs. A common solution for all JUs is currently under discussion, whereby the JUs will pool together in a common 'back-office arrangement' and employee staff who will organise and sign off all accounts for all JUs. This is expected to start in late 2022 and will be applicable for the 2022 JU accounts.

Lastly, the late adoption of the MFF funding programmes and the new EuroHPC JU regulation led to the late Governing Board approval of the new updated 2021 work programme at the end of 2021. This led to a large increase of operational funds from Horizon Europe, DEP and CEF which were commited and as yet unspent. The implementation rate for 2021 is therefore low.

3. R&I ACTIVITIES

R&I activities in 2021 focused mostly on completing of calls and actions initiated in 2019 and 2020 (Legacy projects).

Thirteen consortia signed agreements with EuroHPC JU in 2021 and began to work in April 2021. The projects cover the three topics of the call 'Towards Extreme Scale Technologies and Applications', and use up more than the 70% of the designated funding available under Europe 2020.

The different consortia will work on research and innovation activities that will help Europe to become globally competitive in the field of supercomputing. 10 of these projects[1] will address EuroHPC-01-2019 'Extreme scale computing and data driven technologies'. Another two projects, MICROCARD and REGALE, will focus topic EuroHPC-02-2019 on 'HPC and data centric environments and application platforms'. Finally, the exaFOAM project will concentrate on topic EuroHPC-03-2019 on 'Industrial software codes for extreme scale computing'.[2]

The EuroHPC JU launched a call covering the call "Training and Education on High Performance Computing" for the design and delivery of a **European Master programme in HPC**, the call was launched early in the year and by October the JU was able to announce that the project would go ahead as lead by the University of Luxembourg and in collaboration with 7 other European universities[3].

In 2021, the EuroHPC JU prepared the second phase of the European Processor Initiative project, a cornerstone of the European initiative towards strategic autonomy in HPC, chip technologies and infrastructure which started in 2022 and to build on the achievements of the first phase. Indeed, throughout 2021, the JU evaluated submissions for Call (H2020-JTI-EuroHPC-2020-02) and the Governing Board approved the winning project in late 2021. The original European Processor Initiative project completed its first three-year phase in 2021, delivering cutting-edge technologies, including the RHEA General-Purpose Processor (GPP) and a proof-of-concept implementation of European accelerator technology.

4. EUROHPC PROCUREMENTS

With **five supercomputers becoming operational** over the course of the year, at the end of 2021, the EuroHPC JU is well on its way to its goal of developing an integrated and user-driven hyper-connected world-class supercomputing and data infrastructure. The five operational supercomputers are now available for access under the JU's access policy[4].

One further petascale and two pre-exascale supercomputers are underway. Furthermore, with the new Regulation, a new round of calls for expressions of interest for hosting entities for

[1] Admire, DCoMEX, DEEP-SEA, eProcessor, IO-SEA, Maelstrom, Red Sea, Sparcity, Textarossa, Time-X

[2] See press release: The European High Performance Computing Joint Undertaking launched thirteen R&I projects in April | European High Performance Computer Joint Undertaking (europa.eu)

[3] See press release: University of Luxembourg to lead the first pan-European Master's programme in HPC | European High Performance Computer Joint Undertaking (europa.eu)

[4] Decision 06.2021 - Access policy.pdf (europa.eu)

mid-range and exascale supercomputers were launched in 2021, in order to further expand overall supercomputing power in Europe.

The following systems are operational:

- Vega, hosted by IZUM in Maribor, Slovenia is fully operational
- MeluXina, hosted by LuxProvide in Bissen, Luxembourg is partially operational. Due to delays in the global supply chain, Meluxina only received a partial acceptance, and thus the JU only paid for the completed work. Once this supply issue is resolved, the rest of the payments will be made.
- Discoverer, hosted by consortium Petascale Supercomputer Bulgaria in Sofia, Bulgaria is fully operational
- Karolina, hosted by IT4Innovations in Ostrava, Czech Republic is fully operational
- LUMI, hosted be CSC in Kajaani, Finland, is partially operational

The following systems are underway:

- Leonardo, hosted by CINECA in Bologna, Italy

The data centre that will host the supercomputer is in the process of being built and is expected to be ready in July 2022. The supercomputer is expected to be operational end of 2022.

- Deucalion, that will be installed by MACC in Guimaraes, Portugal

The data centre that will host the supercomputer is in the process of being built and is expected to be ready in July 2022. The supercomputer is expected to be operational end of 2022.

- MareNostrum 5, to be hosted by Barcelona Supercomputing Center in Spain.

The EuroHPC JU re-launched the MareNostrum 5 call to procure a pre-exascale high performance computer which now will be tailored to strengthen European medical research through drug research, the development of vaccines, virus spread simulations as well as artificial intelligence and big data processing applications. The machine will also support traditional HPC applications, such as climate research, engineering, material science and earth sciences.

The system will be hosted in the Barcelona Supercomputing Center in Spain, which has been designed specifically to meet the needs of this supercomputer. The machine will be highly energy efficient, fully powered with green energy, and will utilise heat reuse technology. The supercomputer is expected to be operational in early 2023.

1. IMPLEMENTATION OF THE ANNUAL WORK PLAN 2021

1.1. KEY OBJECTIVES 2021 AND ASSOCIATED RISK

Following the adoption of the new regulation, the JU's mission and objectives were updated and now read as follows:

The mission of the Joint Undertaking shall be: to develop, deploy, extend and maintain in the Union a world-leading federated, secure and hyper-connected supercomputing, quantum computing, service and data infrastructure ecosystem; 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.

The Joint Undertaking shall have the following overall objectives:

- to contribute to the implementation of Regulation (EU) 2021/695 and in particular Article 3 thereof, to deliver scientific, economic, environmental, technological and societal impact from the Union's investments in research and innovation, so as to strengthen the scientific and technological bases of the Union, deliver on the Union strategic priorities and contribute to the realisation of Union objectives and policies, and to contribute to tackling global challenges, including the Sustainable Development Goals by following the principles of the United Nations Agenda 2030 and the Paris Agreement adopted under the United Nations Framework Convention on Climate Change;
- to develop close cooperation and ensure coordination with other European Partnerships, including through joint calls, as well as to seek synergies with relevant activities and programmes at Union, national, and regional level, in particular with those supporting the deployment of innovative solutions, education and regional development, where relevant;
- to develop, deploy, extend and maintain in the Union an integrated, demand-oriented and user-driven hyper-connected world-class supercomputing and data infrastructure;
- to federate the hyper-connected supercomputing and data infrastructure and interconnect it with the European data spaces and cloud ecosystem for providing computing and data services to a wide range of public and private users in Europe;
- to promote scientific excellence and support the uptake and systematic use of research and innovation results generated in the Union;
- to further develop and support a highly competitive and innovative supercomputing and data ecosystem broadly distributed in Europe contributing to the scientific and digital leadership of the Union, capable of autonomously producing computing technologies and architectures and their integration on leading computing systems, and advanced applications optimised for these systems;

- to widen the use of supercomputing services and the development of key skills that European science and industry need.

The Annual Work Plan (AWP) for 2021 was updated accordingly to reflect the new mission and objectives.

New eligibility challenges:

For procurements, a significant change for the JU is that the Governing Board may decide in the Work Programme, if duly justified for security reasons, to condition the participation of suppliers in the acquisition of the supercomputers in accordance with Article 12(6) of Regulation (EU) 2021/694 or to limit the participation of suppliers for security reasons or actions directly related to the Union's strategic autonomy, in accordance with Article 18(4) of that Regulation.

Using a similar procedure as set out above, the Governing Board will also need to into account the new security clauses in Horizon Europe (art 22.5) for future R&I calls in the development of HCP systems and applications.

Another eligibility challenge is the continued involvement of participating states such as Switzerland that had signed association agreements in Horizon 2020 but are no longer members of the European Union or members of the Governing board. Here, ongoing involvement of these states in procurements, calls and access to supercomputers has to be assessed very carefully, on a case-by-case basis, and with guidance from the Commission.

Throughout the year, risks have been managed so that only a minimum arose. One of the key risks identified in 2021 has been the lack of staff, and at the end of 2021 new recruitment procedures were being initiated, to be finalised in 2022. In particular, the Internal Control & Audit role will be prioritised, to enable the EuroHPC JU to be better identify, prevent and mitigate risks in the future. Furthermore, to ensure good financial management and to further develop the JU's technical expertise in HPC R&I and procurement, the recruitment of finance and project officers were also prioritised. At the end of 2021, six recruitment procedures were launched.

1.2. RESEARCH & INNOVATION ACTIVITIES

Due to the end of the Horizon 2020 programme, no new R&I calls were proposed in 2021.

Research and innovation (R&I) activities that were originally initiated in Annual Work Plan 2019 and 2020 (in line with Regulation 2018/1488) but had not been launched in those years, were re-introduced in the Annual Work Plan (AWP) 2021 (N+3 Rule). These activities covered technologies, applications, and training and skills.

Furthermore, all new Regulation R&I activities funded with new MFF funding (Horizon Europe and Digital Europe Programme) will be launched in 2022.

Under Regulation 2018/1488, R&I activities were centred around five calls:

- Call **H2020-JTI-EuroHPC-2019-1** focused on the development of technologies and applications for the first European exascale systems. In 2021, grant agreements were signed with several consortia to develop hardware, software, algorithms, and to prepare applications for the next generation of supercomputers.

- Call **H2020-JTI-EuroHPC-2019-2** permitted the launch of a pan-European network of national HPC Competence Centres, a major step towards a European HPC ecosystem was achieved. Centres of Excellence will promote significant HPC pan-European initiatives, such as the access to EuroHPC supercomputers at country level, will help to broaden HPC skills across the Union, support specific requirements for the adoption of HPC by local communities in 33 European countries, and provide support for Small and Medium-sized Enterprises (SMEs). In 2021, EuroHPC JU organised project review sessions (online due to the pandemic) to assess different activities of the Competence Centres. The findings of these evaluations will be used to develop future calls in this field.

- Call **H2020-JTI-EuroHPC-2020-01** on the first pilots for European supercomputers was launched in 2020. The call included pilots towards the European exascale supercomputers as well as a pilot on a quantum simulator. Following the subsequent evaluation of proposals in 2020, the winning projects signed agreements in 2021.

- Call **H2020-JTI-EuroHPC-2020-02** was launched in 2020 within the Framework Partnership Agreement (FPA) in European low-power microprocessor technologies (Phase 2). In 2021, the JU evaluated submissions for Call and the Governing Board approved the winning project in late 2021.

- In 2021, a pilot for a pan-European MSc Programme for HPC (Call **H2020-JTI-EuroHPC-2020-03)** was approved. At least two cohorts of students will be educated within this academic initiative and graduate with MSc degree after two years. The curriculum will address the requirements of a broad range of European stakeholders in HPC, in particular the transfer of skills from academia to the private sector. The first cohort of Masters students will begin their Masters Course in Autumn 2022.

1.2.1. Calls for proposals

As indicated above, activities related to five calls were carried out by the EuroHPC JU during 2021.

CALL	NON-PROFIT	FOR-PROFIT
H2020-JTI-EuroHPC-2019-1		
EuroHPC-01-2019 (RIA)	50%	50%
EuroHPC-02-2019 (IA)	50%	35%
EuroHPC-03-2019 (IA)	50%	35%
H2020-JTI-EuroHPC-2019-2		
EuroHPC-04-2019		
CSA	100%	100%
RIA	50%	50%
EuroHPC-05-2019 (RIA)	100%	100%
H2020-JTI-EuroHPC-2020-01		
EuroHPC-2020-01-a (RIA)	50%	50%
EuroHPC-2020-01-b (RIA)	50%	50%
H2020-JTI-EuroHPC-2020-02 (SGA)	50%	50%
H2020-JTI-EuroHPC-2020-03 (CSA)	100%	100%

Table 1 Funding rates for all calls managed in 2021

1.2.2. Summary and state of play of each call

- Call H2020-JTI-EuroHPC-2019-1 (Towards Extreme Scale Technologies and Applications)

The call *H2020-JTI-EuroHPC-2019-1* invited applications for a broad range of topics with the overarching goal of developing hardware and software for the next generation of European

exascale HPC systems. Major challenges addressed in this call are technologies that efficiently exploit novel and increasingly heterogeneous system architectures and achieve high performance at low-power consumption. Proposals were expected to exhibit significant impact in science, industry, and society and align with existing and preceding Research and Development activities in Europe.

- The objective of the call topic *EuroHPC-01-2019* (Extreme scale computing and data driven technologies) was addressed in five sub-topics. Each subtopic focuses on a specific aspect of HPC technology, including application performance, data management[5], network and Input/Output (I/0) technology, mathematical methods and algorithms, and the development of a software stack. The proposals are expected to focus on evolving HPC architectures and address performance and efficiency on future exascale systems. Moreover, proposals are requested to leverage ongoing efforts to develop energy efficient hardware in European low-power processing technologies and other European initiatives.
- The objective of the call topic *EuroHPC-02-2019* (HPC and data centric environments and application platforms) was on HPC solutions with relevance for the European industry and society i.e. the development of energy-efficient HPC software. In particular, the topic addresses software environments and application-oriented platforms to implement complex application workflows. The proposals are expected to demonstrate significant use cases and pilot systems.
- The objective of the call topic *EuroHPC-03-2019* (Industrial software codes for extreme scale computing environments and applications) was centred around the further development, adaptation, and optimization of HPC software for applications in the European industry. Proposals should exploit synergies with existing solutions and open-source projects where appropriate. Significant market impact should be achieved by the projects, creating substantial value in Europe.

The call was published with an indicative JU contribution of EUR 55 million on 25 July 2019 and closed on 14 January 2020. In this call, 20 projects were approved of which 11 were signed in 2020 and 9 more were signed in 2021. (See more detail in section 1.2.5)

➢ Call H2020-JTI-EuroHPC-2019-2 Innovating and Widening the HPC use and skills base

This call addressed three different strategic initiatives.

- The objective of the call topic *EuroHPC-04-2019* was to set up and operate one HPC Competence Centre to support the development of the HPC ecosystem in a maximum number of countries participating in the EuroHPC JU. The HPC Competence Centre should provide leading-edge, innovative solutions taking into account national HPC requirements emanating from different users (industry, academia, public

[5] For a summary of all Calls, please go to annex 6

administrations) and develop the necessary expertise in collaboration with the national user community. National HPC Competence Centres should implement a flexible and modular approach in the services to be provided, taking into account the degree of maturity of the national HPC infrastructure.

- The Coordination and Support Action of topic *EuroHPC-4-2019* should provide support to the National Competence Centres. In particular, the action should establish a communication platform, facilitate dialogue among centres, promote the objectives of the HPC Competence Centres, and organize outreach events and workshops (on topics identified by the National Competence Centres). Proposals were expected to identify potential training solutions and tools available from the HPC Competence Centres network to support and assist National Competence Centres. Furthermore, the proposed action should implement a networking and coordination platform for national and European activities including mentoring and twinning schemes between National Competence Centres.
- Topic *EuroHPC-5-2019* addressed innovative European SMEs, focusing on the engineering and manufacturing sector. Its aim is to implement an open and competitive funding programme to unlock the innovation potential of European SMEs through support with world-class HPC knowledge and services, combining academic expertise and industrial research to develop market-ready products and business opportunities.

The call was published with an indicative EuroHPC JU contribution of EUR 40 million on 25 July 2019 and closed on 14 November 2019. In this call, 3 projects were approved and were signed in 2020 (before the JU's autonomy). (See more detail in section 1.2.5).

➢ Call H2020-JTI-EuroHPC-2020-01 on Advanced pilots towards the European supercomputers and a Pilot on quantum simulator:

The call for proposals invited applications for the implementation of pilot systems to (demonstrate the integration of European technology in HPC systems. The pilots support the development of hardware and software for the next generation of European exascale HPC systems. The central challenge of this call was the implementation of a prototype HPC system on the basis of technology developed in preceding R&I actions such as the European Processor Initiative. The two topics of the call covered the integration of different European technology building blocks including processors, accelerators and cooling systems, as well as the integration of a quantum simulator in an existing HPC system.

- Topic *EuroHPC-2020-01-a* focused on the implementation of advanced pilots towards the European supercomputers. The challenge defined by this topic is divided into two complementary pilot systems. One pilot is expected to specifically address the integration of European low-power processor technologies. A second and complementary system is expected focus on European open-hardware solutions, such as RISC-V and accelerator technology, which will be part of future European exascale systems. Proposals should demonstrate energy power efficiency, usability, resiliency and scalability of the prototype systems. The JU committed contributions of EUR 22 million and EUR 15 million for the two pilot systems, respectively.

- Topic *EuroHPC-2020-01-b* called for the development of a pilot on quantum simulator. Focus of action is the development of a first quantum computing simulator in the Union. Specifically, the proposed solutions should address the hybridization of quantum and classical HPC systems. A quantum simulator providing 100+ qubits should be installed at a hosting site of a European EuroHPC or Tier-0 supercomputer and a corresponding cloud-based platform for user access developed. The quantum simulator is expected to complement the co-located HPC system addressing challenges beyond the current scope of classical systems and support the development of new software for future quantum computers and applications. A JU contribution of up to EUR 6 million was available for this topic.

The call was published with an indicative EuroHPC JU contribution of EUR 43 million on 16 April 2020. Topic EuroHPC-2020-01-a closed on 15 September 2020. Topic *EuroHPC-2020-01-b* closed on 28 July 2020. In 2021, grant agreements for two projects were signed by the JU (See more detail in section 1.2.5).

➢ Call H2020-JTI-EuroHPC-2020-02 on Framework Partnership Agreement in European low-power microprocessor technologies (Phase 2)

With a maximum JU contribution of EUR 35 million was launched in September 2020 and was evaluated in 2021. The Governing Board selected the winning project in late 2021 and the grant agreement was signed in 2022. The call invited the consortium of the Framework Partnership Agreement (FPA) in European low-power microprocessor technologies to submit a proposal for the second phase of the European Processor Initiative (EPI). The proposal should address the second phase of the design and development of European low-power processors and related technologies for extreme-scale, high-performance big-data, AI and emerging applications, in accordance with the research roadmap defined in the respective FPA. The scope of the call encompasses the development of the second generation of low-power general purpose processing system units, the development of the second generation of low-power processing system units for application acceleration, the validation of the first generation of low-power processing system units developed in Phase 1 (and Phase 2), and support for a hardware and software development platform common to different processor and accelerator types.

➢ Call H2020-JTI-EuroHPC-2020-03 on Training and Education on High Performance Computing

This call was launched in 2021 to develop and implement the pilot(s) of the European Master of Science (MSc) programme(s) for High Performance Computing (HPC). The graduate education programme(s) will focus HPC and HPC-usage. The selected proposal(s) will demonstrate the added value of a pan-European education programme, committed to academic excellence, that offers students an outstanding career perspective in international

companies and research institutes. A budget of up to EUR 7 million was foreseen for the grant(s). The Governing Board approved the winning project which will be led by the University of Luxembourg with 7 other European Universities and the grant agreement was signed in 2022.

1.2.3. Evaluation procedures

The evaluation of proposals for all calls followed the rules set out in the Horizon 2020 (H2020) framework programme. The evaluation was made against the three standard H2020 evaluation criteria (excellence, impact and implementation).

The evaluation procedure was carried out with assistance of external experts, beginning with an initial individual evaluation, followed by a consensus group and concluding with the panel review. Each admissible and eligible proposal was evaluated by at least three external experts. The external experts were selected in a way to ensure a high level of skills, experience, and knowledge in the areas of the call (including project management, innovation, exploitation, dissemination, and communication). Special attention was given to achieve a well-balanced composition in terms of skills, experience, knowledge, geographical diversity, gender, and affiliation with organisations in the private and public sector. One redress request on the eligibility check of call H2020-JTI-EuroHPC-2020-01 was filed during the reporting period. The redress committee, which was established according to the procedures set out in the H2020 framework programme, concluded that the redress request was not substantiated and confirmed the result of the eligibility check carried out by the EuroHPC JU.

CALL	NO OF PROPOSALS	TTI	TTS	TTG
H2020-JTI-EuroHPC-2019-1	38	182	154	346
H2020-JTI-EuroHPC-2019-2	3	117	143	260
H2020-JTI-EuroHPC-2020-01	5	152	308	457
H2020-JTI-EuroHPC-2020-02	1	161	178	339
H2020-JTI-EuroHPC-2020-03	6	112		
Total Average	**53**	**167**	**171**	**348**

Table 2 Number of submitted eligible proposals, average Time-to-Inform (TTI), Time-to-Sign (TTS) and Time-to-Grant (TTG, sum of TTI and TTS)

Table 2 shows the average Time-to-Inform (TTI), Time-to-Sign (TTS) and Time-to-Grant (TTG) for the submitted eligible proposals. The grant agreement preparation was delayed due to the COVID-19 situation.

1.2.4. Participation and awarded grants

The calls for proposals attracted applications with participants from a large number of European countries. Among all the successful consortia, 33 European countries are represented with at least one beneficiary. The participations of SMEs and LEs are lower than their representation among all unique beneficiaries. This indicates that some public institutions (Other), such as higher or secondary education establishments and research organisations, on average, participate in more proposals compared to private companies. The statistical analysis further shows that the representation of beneficiaries in all submitted eligible and successful proposals are very similar, emphasizing an unbiased evaluation process with respect to the different types of participating entities.

ENTITY	PARTICIPATIONS	BENEFICIARIES	SUCCESSFUL BENEFICIARIES
SME	13%	19%	21%
LE	11%	15%	16%
Other	76%	67%	63%

Table 3 Participations and unique beneficiaries in all and successful (funded) proposals by type of entity. The category Other refers mostly to public bodies.

In total, 299 different legal entities participated as beneficiaries in the five calls with ongoing projects in the reporting period. Most of the participating entities applied as a partner in one proposal (71%). Only very few beneficiaries participated in more than 10 proposals (2%). One beneficiary with an exceptionally high participation in 23 proposals was a partner in 43% of all submitted proposals. The very high participation frequency of few entities is also evident from the distribution of requested EU grants among the participants. While 235 beneficiaries requested a total EU grant for all participations up to EUR 1 million, 23% of the total requested EU funds can be attributed to four beneficiaries. Since the success rate was approximately proportional to the participation rate, a similar distribution of requested and awarded grants is observed. This apparent imbalance can be explained by the critical role of some large European HPC centres and HPC vendors for the R&I activities in many consortia. In particular, the EuroHPC JU's initiatives on HPC adoption by local communities, training and skills as well as the procurement activities to equip a larger number of European HPC centres with state-of-

the-art supercomputers are expected to mitigate the currently observed clustering of projects and resources in the future. Regarding beneficiaries among the Private Members of the EuroHPC JU, members of the ETP4HPC and BDVA, a high success rate is observed. For example, for members of the ETP4HPC the success rate in all proposals managed by the JU during the reporting period is 89%. The success rate of 78% for the members of the BDVA was found above the average success rate for all beneficiaries (64%).

PARTICIPATIONS	NO OF BENEFICIARIES
1	213
2	35
3	18
4	9
5	7
6	2
7	3
8	4
9	1
10	1
11	1
13	1
14	1
16	2
23	1

Table 4 Total number of participations in all three evaluations of the reporting period and corresponding number of unique legal entities.

GRANT REQUESTED (M€)	NO OF BENEFICIARIES
0-1	235
1-2	32
2-3	13
3-4	8
4-5	6
8-9	1
10-11	1
12-13	1
14-15	1
24-25	1

Table 5 No of beneficiaries participating in the three evaluations in 2020 which requested an EU grant in the respective range.

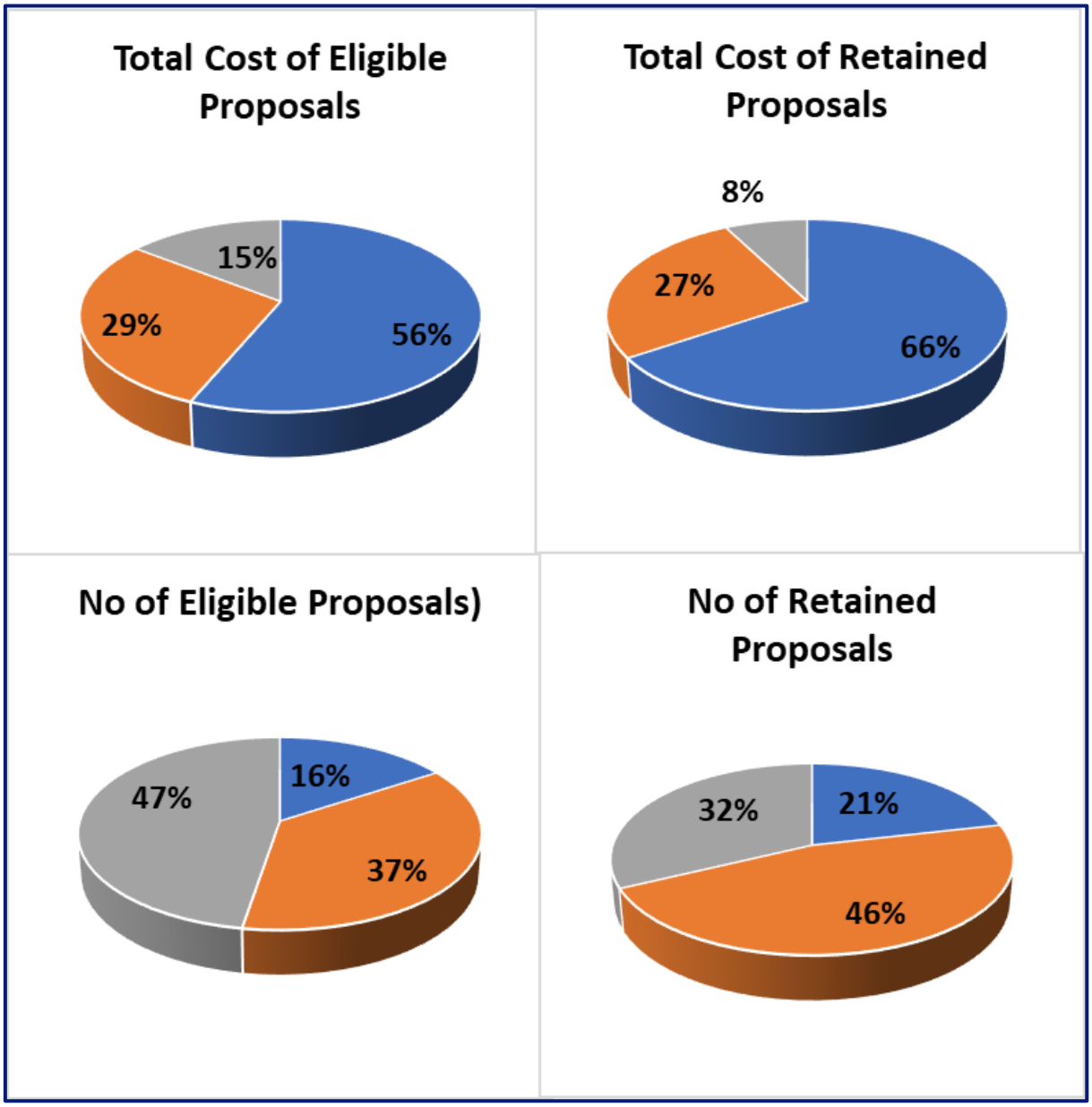


Figure 1 Distribution of total cost and number of proposals for all eligible proposals (left) and retained proposals (right according to the classification in large, medium and small proposals.

CALL	SUCCESSFUL PROPOSALS	TOTAL COST (TOTAL)	REQUESTED EU FUNDING (TOTAL)	REQUESTED EU FUNDING (SME)	REQUESTED EU FUNDING (LE)
H2020-JTI-EuroHPC-2019-1	20	€119,720,515	€55,942,816	€5,613,553	€9,311,923
EuroHPC-01-2019	10	€65,951,496	€31,895,771	€2,965,274	€5,535,425
EuroHPC-02-2019	5	€30,823,691	€13,990,664	€1,064,797	€2,055,320
EuroHPC-03-2019	5	€22,945,329	€10,056,381	€1,583,482	€1,721,178
H2020-JTI-EuroHPC-2019-2	3	€68,340,176	€39,941,028	€596,563	€1,240,625
EuroHPC-04-2019	2	€58,341,701	€29,942,553		€1,240,625
EuroHPC-05-2019	1	€9,998,475	€9,998,475	€596,563	
H2020-JTI-EuroHPC-2020-01	3	€84,486,804	€41,380,902	€4,148,251	€16,689,528
EuroHPC-2020-01-a	2	€70,761,804	€35,380,902	€3,871,405	€15,979,981
EuroHPC-2020-01-b	1	€13,725,000	€6,000,000	€276,846	€709,547
H2020-JTI-EuroHPC-2020-02	1	€78,972,885	€39,486,443	€15,885,179	€8,495,369
EuroHPC-2020-02	1	€78,972,885	€39,486,443	€15,885,179	€8,495,369
H2020-JTI-EuroHPC-2020-03	1	€7,028,058	€6,999,999		
EuroHPC-2020-03	1	€7,028,058	€6,999,999		
GRAND TOTAL	28	€358,548,437	€183,751,188	€26,243,546	€35,737,445

Table 4 No of retained proposals and corresponding financial information including breakdown in funds requested by SMEs and LEs.

Table 6 shows a detailed breakdown of funds for the different calls and topics. On average 11 partners from 6-7 different countries participate in a proposal. 13% of the EU funds have been requested by SMEs and 14% of all awarded EU funds are designated to SMEs. Approximately 19% of the total available EU contributions were granted to large enterprises (LEs). The most significant contributions to LEs are planned for the advanced pilots towards the European supercomputers in call H2020-JTI-EuroHPC-2020-01 and topic EuroHPC-2020-01-a as well as the European Processor Initiative in call H2020-JTI-EuroHPC-2020-02.

As illustrated in Table 6, the calls attracted submissions with a broad participation from many European countries. The data demonstrate the wide participation of entities from both the public and private sector in Europe. With 21% SME beneficiaries and 16% beneficiaries of large enterprises, the actions contribute to a competitive and prosperous European economy in HPC sector.

COUNTRY	BENEFICIARIES	SME	LE	COUNTRY	BENEFICIARIES	SME	LE
AT	7	3	1	**IT**	43	7	8
BE	10			**LT**	1		
BG	4			**LU**	2		
CH	10	1	1	**LV**	1		
CY	2			**MK**	1		
CZ	6			**NL**	7	1	1
DE	51	9	3	**NO**	9		1
DK	2			**PL**	5		
EE	1			**PT**	9		
EL	13	4	2	**RO**	5		
ES	21	3	1	**SE**	8		
FI	3			**SI**	4	1	
FR	46	10	12	**SK**	2	1	
HR	4			**TR**	7		
HU	3			**UK**	4		1
IE	3			**TOTAL**	**295**	**40**	**31**
IS	1						

Table 5 Beneficiaries, SMEs and LEs participating in awarded grants of the three calls evaluated in 2020.

Table 7 provides an overview on the country-specific financial contributions of the JU for all funded proposals which were managed by the JU in 2021. The data reflect the participation statistics presented in Table 6.

COUNTRY	TOTAL COST (TOTAL)	REQUESTED EU FUNDING (TOTAL)	REQUESTED EU FUNDING (SME)	REQUESTED EU FUNDING (LE)
AT	€3,734,860	€1,835,423	€268,649	€52,041
BE	€3,102,609	€1,613,492		
BG	€1,262,188	€764,688		
CH	€10,434,765	€4,973,708	€156,844	€156,625
CY	€2,249,550	€1,124,775		
CZ	€4,642,969	€2,384,531		
DE	€67,852,826	€38,784,000	€4,163,642	€312,725
DK	€2,030,625	€1,000,000		
EE	€2,000,000	€1,000,000		
EL	€16,528,170	€8,074,491	€749,094	€1,314,313
ES	€36,084,005	€18,314,076	€3,942,040	€50,897
FI	€1,993,099	€996,549		
FR	€110,110,887	€54,932,272	€12,809,557	€28,078,423
HR	€4,147,230	€2,073,615		
HU	€2,345,813	€1,035,938		
IE	€2,683,370	€1,341,685		
IT	€41,821,626	€19,795,821	€3,644,159	€4,799,747
LT	€285,000	€142,500		
LU	€3,965,469	€2,761,786		
LV	€1,000,000	€500,000		
MK	€1,825,490	€912,745		
NL	€1,619,600	€756,050	€192,500	€386,050

NO	€4,938,515	€2,469,258		€64,750
PL	€3,238,156	€1,550,756		
PT	€3,439,469	€1,764,663		
RO	€2,000,000	€1,000,000		
SE	€9,072,098	€4,656,018		
SI	€2,413,288	€1,323,938	€206,438	
SK	€1,419,450	€709,725	€110,625	
TR	€3,350,485	€1,680,274		
UK	€6,956,828	€3,478,414		€521,875
TOTAL	**€358,548,437**	**€183,751,188**	**€26,243,546**	**€35,737,445**

Table 6 Breakdown of awarded grants by country as indicated by the participants. The figures are based on original data submitted with the proposals and may differ in the final grant agreement.

1.2.5. Portfolio analysis

The R&I actions managed during the reporting period cover a wide range of topics, including technology, applications as well as training and skills. Dedicated actions to address European SMEs needs and prepare the development of the first exascale supercomputers based on European technology have been launched. A more detailed overview of the individual projects (including signature of agreement) is provided in the table below.

CALL	PROPOSAL	OBJECTIVE	COORDINATOR NATIONALITY	GRANT AGREEMENT SIGNED
H2020-JTI-EuroHPC-2019-1	ACROSS	High-Performance Computing, Big Data and Artificial Intelligence convergent platform, workflows and applications to aeronautics, climate and weather, and energy domains	IT	2020

H2020-JTI-EuroHPC-2019-1	ADMIRE	To create an active I/O stack that dynamically adjusts computation and storage requirements through intelligent global coordination, malleability of computation and I/O, and the scheduling of storage resources along all levels of the storage hierarchy	ES	2020
H2020-JTI-EuroHPC-2019-1	DComEX	Novel scalable library of AI-enhanced algorithms for the solution of large scale sparse linear system, application to cancer immunotherapy and composite materials	EL	2020
H2020-JTI-EuroHPC-2019-1	DEEP-SEA	To deliver a programming environment for future European exascale systems, adapting all levels of the software stack	DE	2020
H2020-JTI-EuroHPC-2019-1	eFlows4HPC	Workflows as a service for High-Performance Data Analytics, Machine Learning and High-Performance Computing, simulations for manufacturing (digital twins) and natural phenomena	ES	2021
H2020-JTI-EuroHPC-2019-1	eProcessor	Development of an open source out-of-order RISC-V processor, related intellectual property building blocks and software	ES	2020
H2020-JTI-EuroHPC-2019-1	exaFOAM	improvement of the OpenFOAM software for computational fluid dynamics across the entire	FR	2021

		process chain (pre-processing, simulation, I/O, postprocessing)		
H2020-JTI-EuroHPC-2019-1	HEROES	Implementation of a software solution for HPC-platform selection, adapted to simulation tasks of scientific and industrial users, and its application using marketplace concepts	FR	2020
H2020-JTI-EuroHPC-2019-1	IO-SEA	Develop a data management and storage platform for exascale computing, based on hierarchical storage management and on-demand provisioning of storage services	FR	2021
H2020-JTI-EuroHPC-2019-1	LIGATE	Implement a computer-aided drug design solution for automated drug discovery	IT	2020
H2020-JTI-EuroHPC-2019-1	MAELSTROM	Develop a software environment to combine machine learning with established simulation techniques for weather and climate modelling	UK[6]	2020
H2020-JTI-EuroHPC-2019-1	MICROCARD	Develop a production-ready simulation platform for cardiac electrophysiology for models with micrometer resolution	FR	2021
H2020-JTI-EuroHPC-2019-1	NextSim	development of a numerical flow solver, adapted to new HPC architectures, for computational	ES	2021

[6] Maelstrom is coordinated by ECMWF (European Centre for Medium-Range Weather Forecasts) which has its headquarters in in Reading, UK.

		fluid dynamics applications in the aeronautical industry		
H2020-JTI-EuroHPC-2019-1	OPTIMA	Optimize selected industrial applications and open-source libraries for HPC systems including field programmable gate arrays	EL	2021
H2020-JTI-EuroHPC-2019-1	RED-SEA	Develop the next generation of European exascale interconnects for modular supercomputer architectures	FR	2020
H2020-JTI-EuroHPC-2019-1	REGALE	Improve resource management at HPC centres by integrating and optimising components covering the entire process cycle	EL	2021
H2020-JTI-EuroHPC-2019-1	SCALABLE	Transfer of leading technology from public-domain research software to an industrial simulation software for computational fluid dynamics	FR	2021
H2020-JTI-EuroHPC-2019-1	SPARCITY	Maximising the performance and energy efficiency of sparse computations on emerging HPC systems	TR	2020
H2020-JTI-EuroHPC-2019-1	TEXTAROSSA	Advance innovative power and thermal management solutions, develop novel intellectual property for reconfigurable accelerators in heterogeneous HPC multi-node platforms	IT	2020

H2020-JTI-EuroHPC-2019-1	TIME-X	Advance parallel-in-time integration from an academic methodology into a widely available technology adapted to current and future exascale HPC Architectures	BE	2020
H2020-JTI-EuroHPC-2019-2	CASTIEL	combine the National Competence Centres for HPC created in the EuroCC project into a pan-European network	DE	2020
H2020-JTI-EuroHPC-2019-2	EUROCC	create national competence centres for HPC to elevate the participating countries to a common high level in the fields of HPC, high-performance data analytics and artificial intelligence	DE	2020
H2020-JTI-EuroHPC-2019-2	FF4EuroHPC	Promote innovation using high-performance computing in small and medium-sized enterprises across Europe	DE	2020
H2020-JTI-EuroHPC-2020-01	EUPEX	Design, build, and validate the first prototype HPC system gathering European technology from different R&I activities including the European Processor Initiative and the Modular Supercomputing Architecture	FR	2020
H2020-JTI-EuroHPC-2020-01	HPCQS	Develop the programming platform and deploy a twin pilot system for a quantum simulator with 100+ qubits in each system, offer hybrid HPC/quantum	DE	2021

		simulator resources to users and application developers		
H2020-JTI-EuroHPC-2020-01	The European PILOT	Demonstrate RISC-V based accelerators coupled to any general purpose processor and deliver a full software stack including middleware, runtimes, compilers, and tools for the emerging RISC-V ecosystem	ES	2021
H2020-JTI-EuroHPC-2020-02	EPI SGA2	Develop a European microprocessor and accelerator for HPC and beyond, second implementation phase of the European Processor Initiative within the Framework Partnership Agreement (FPA) in European low-power microprocessor technologies	FR	2022
H2020-JTI-EuroHPC-2020-03	EUMaster4HPC	Pilot for a pan-European MSc Programme on HPC	LU	2022

The portfolio analysis demonstrates that proposals under JU management during the reporting period cover all R&I pillars of the JU. The comprehensive portfolio of activities include technologies and applications (H2020-JTI-EuroHPC-2019-1, H2020-JTI-EuroHPC-2020-02), coordination actions widen HPC use and skills across the Union (H2020-JTI-EuroHPC-2019-2, H2020-JTI-EuroHPC-2020-03) and the first pilot systems demonstrating European technology for future supercomputers (H2020-JTI-EuroHPC-202-01).

1.2.6. Experts

The widespread HPC expertise in Europe is not only reflected by the participation of most European countries in the JU's R&I activities, but also in the geographical distribution of experts that have supported the JU in the implementation of the actions. The participation of leading

experts from all European regions demonstrates the fair, transparent, and scientifically sound implementation of the selection and ranking of proposals as well as in the assessment of projects during reviews. A total number of 45 experts participated in the evaluations and project reviews associated to the five calls. Experts with 24 different nationalities including AT, BE, BG, CH, CY, CZ, DE, DK, EL, ES, FI, FR, HR, IE, IT, LT, LV, PL, PT, RO, SE, SI, TR, and UK contributed. Overall 53 proposals were submitted to five calls. With 47% female and 53% male experts an appropriate gender balance was achieved. On average, every expert evaluator assessed 5 proposals.

CALL	AVERAGE NO. OF PROPOSALS PER EVALUATOR	NO. OF FEMALE EXPERTS	NO. OF MALE EXPERTS
H2020-JTI-EuroHPC-2019-1	5.8	13	13
H2020-JTI-EuroHPC-2019-2	3.0	3	3
H2020-JTI-EuroHPC-2020-01	2.5	3	6
H2020-JTI-EuroHPC-2020-02	1.0	1	3
H2020-JTI-EuroHPC-2020-03	6.0	4	2

1.2. CALL FOR TENDERS AND PROCUREMENTS – HPC INFRASTRUCTURE ACTIVITIES

1.2.7. Procurement of supercomputers (2021)

In 2019, EuroHPC JU launched 8 Calls for Tender for 3 pre-exascale and 5 petascale supercomputers. For 6 of these systems, the contracts were awarded and signed in 2020. These were the procurements for the following systems:

- LUMI, hosted be CSC in Kajaani, Finland,
- Leonardo, hosted by CINECA in Bologna, Italy
- Vega, hosted by IZUM in Maribor, Slovenia
- Karolina, hosted by IT4Innovations in Ostrava, Czech Republic
- MeluXina, hosted by LuxProvide in Bissen, Luxembourg
- Discoverer, hosted by consortium Petascale Supercomputer Bulgaria in Sofia, Bulgaria

The contract for one more petascale system was signed in February 2021. This is related to the supercomputer Deucalion that will be installed by MACC in Guimaraes, Portugal. The contract was awarded to Fujitsu Technology Solutions LDA with a total value of EUR 20.2 million (EU/JU Contribution is 35%: EUR 6.9 million).

The procurement process for MareNostrum 5, the third pre-exascale system to be hosted by Barcelona Supercomputing Centre in Spain, was cancelled by the Governing Board in May 2021. The specifications for the system were redesigned in order to satisfy the updated requirements stemming from the Covid-19 pandemic and from applications in the areas of Artificial Intelligence and Big Data Analytics. A new procurement process was launched in December 2021. The process is expected to conclude by June 2022 and the system installation should begin in Autumn this year.

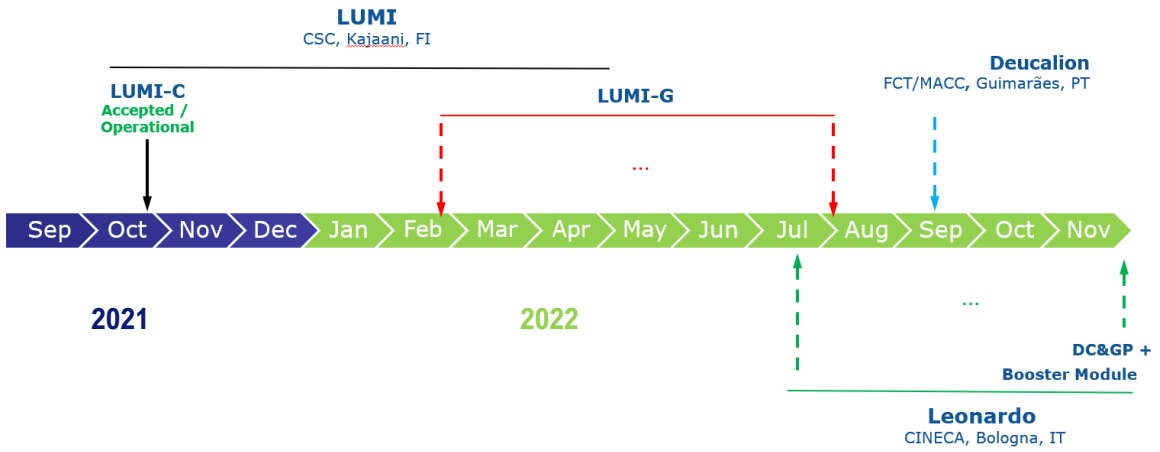


Figure 2 Expected EuroHPC supercomputer pending procurement timeline

Access to EuroHPC Supercomputers

As well as acquiring supercomputers, EuroHPC JU is now managing the Union's access time to these supercomputers (from 35% up to 50% of their total capacity). Access time is to be allocated to European scientific, industrial and public sector users, matching their demanding application requirements, according to the principles stated in the EuroHPC JU Council Regulation. The supercomputing infrastructure comprises a significant investment of the JU members and therefore it was important to define proper rules and procedures for providing access to these.

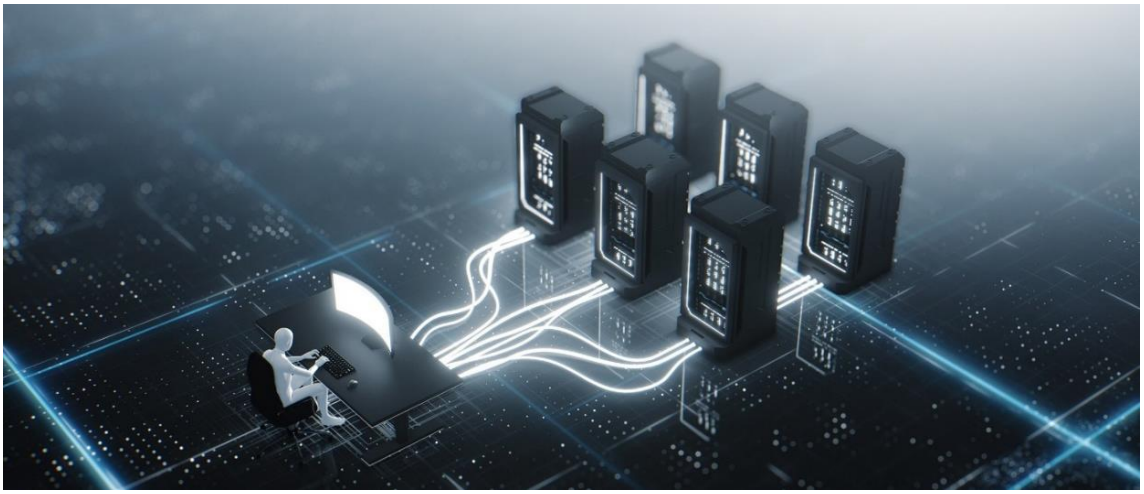


Figure 3 3 © image by photographer or artist - Getty / copyright holder

Much emphasis has been placed on the need for the computation time to be offered to projects which will maximise the positive impact of the systems on R&I and commercial activities in Europe. A well-defined access policy was therefore adopted in March 2021 to ensure optimal allocation of resources and maximise the return of investment of the involved supercomputing systems.

The first call for access time on EuroHPC supercomputers was launched in March 2021, in preparation for Vega becoming operational in April. At the start of June, the first experimental applications to receive access time on a EuroHPC supercomputer were launched.

Following the adoption of the EuroHPC access policy, the regular access mode call to the computing resources of the EuroHPC JU was made available in November 2021 through a call for proposals organised by the EuroHPC JU.

Access time was from then on allocated to European scientific, industrial and public sector users, matching their demanding application requirements, in line with the principles stated in the EuroHPC JU Council Regulation and the JU's Access Policy. The calls are being managed in collaboration with the Partnership for Advanced Computing in Europe (PRACE).

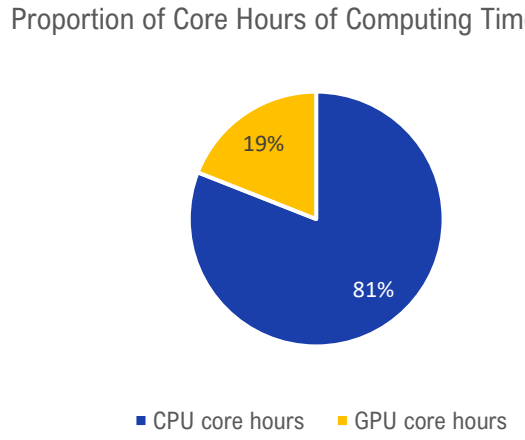
Members of academia, research and industry were able to apply for computation time on EuroHPC machines to support their large-scale projects with significant needs in terms of compute time, data storage, and support resources. This call is now continuously open with

three cut-off dates per year, which trigger the evaluation of the proposals submitted. The proposals are evaluated and ranked by the JU's access committee, composed of European experts, and are then recommended to be awarded access time.[7]

The hosting entities for Vega and Karolina have provided reports detailing the computation time on these systems, with details such as the type of applications running on the supercomputers, the scientific domains these applications come from, the types of organisations which have received access time, the countries that the organisations are based in, and the number of CPU and GPU hours allocated.

Vega's computing time was allocated to 36 different applications during 2021. Of those, 34 were run by research organisations, one is an academic and research institution, and one is an SME. The applications represented 8 different research fields and were run by organisations from 16 different countries.

The core computing hours for Vega amounted to 53,824,000 core hours allocated, with 43,584,000 of those representing CPU hours and 10,240,000 GPU hours.

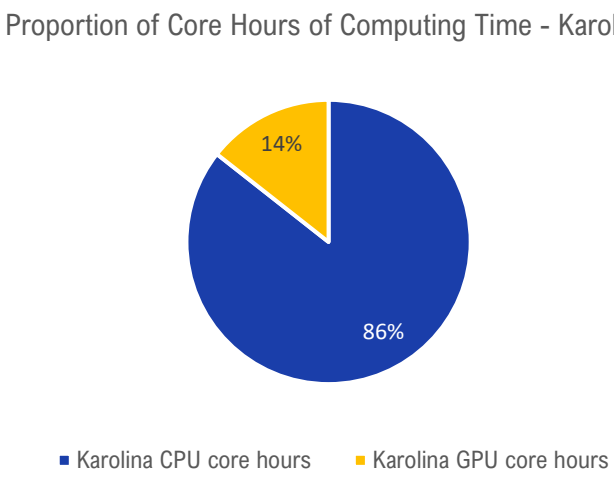


As of the end of 2021, 13 different applications had been allocated computing time on Karolina, with the first applications online in September 2021.

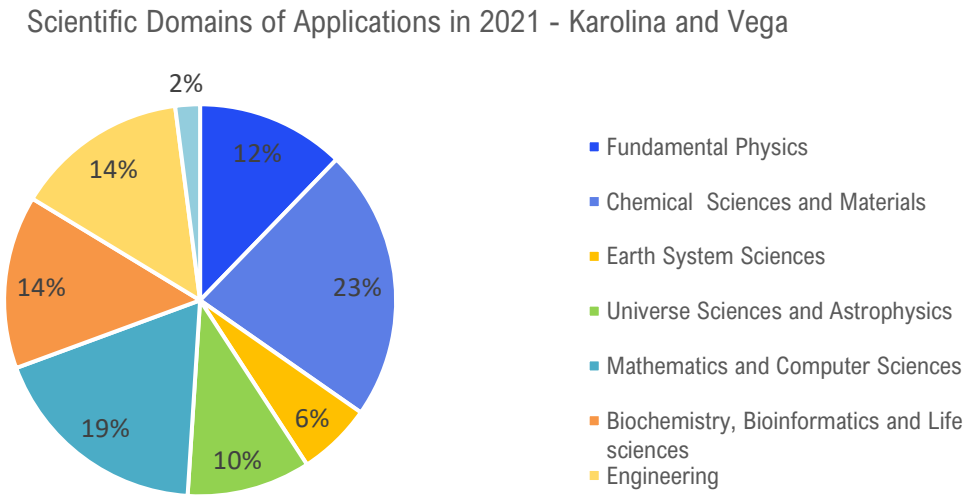
100% of Karolina users in 2021 were research institutions, and these came from 10 different European countries, running applications from 6 different research fields.

In terms of core hours, 6,149,888 of allocated hours were CPU, and 1,033,984 were GPU.

[7] Press Release: Access to EuroHPC supercomputers is now open | European High Performance Computer Joint Undertaking (europa.eu) 10 November 2021



Across both supercomputers, 49 applications in eight different scientific domains received access time, with “Chemical Science and Materials” and “Mathematics and Computer Science” being the most represented, with 11 and nine applications from each field respectively.



Although not all of the hosting entities were able to provide data on computing time for 2021, the reports provided for Vega and Karolina already show, after just a few months of being operational, many applications from a broad range of research fields. It is clear from these reports that the vast majority of institutions having received access in 2021 are research groups. As more EuroHPC supercomputers become operational and more applications gain access time through the JU’s regular access calls, it is likely the range of applications will broaden further, and will allow the EuroHPC JU to provide access to many more applications from a wider array of scientific domains, countries and types of institutions.

1.2.1. Global view on EuroHPC systems/ global standing of EuroHPC systems

The installation of 4 petascale supercomputers were completed and the systems were put to operations in 2021. These supercomputers are Vega, Karolina, MeluXina and Discoverer. One partition of the LUMI supercomputer, LUMI-C, was also completed and is now operational. The LUMI supercomputer installation will be completed with the addition of LUMI-G partition (the GPU-based part of the supercomputer) which is currently under installation and expected to go online in summer 2022. Installation of Leonardo and Deucalion is also ongoing, and the systems are expected to be completed in Q4 2022.

The operational systems were ranked in the Top500.org list of the most powerful supercomputers in the world. In the table below we list the ranking and performance in Petaflops of all ranked EuroHPC supercomputer, as of the day of start of operations.

System partition name	Linpack Performance (PFlops)	Top500 ranking (on first listing)	Green500 ranking (on first listing)
LUMI-C	6.30	76	60
Discoverer	4.52	91	210
Karolina CPU	2,84	149	51
Karolina GPU	6,75	69	8
MeluXina Cluster Module	10.52	230	47
MeluXina Accelerator Module	2.29	36	4
Vega CPU	3,82	106	300
Vega GPU	3,10	134	301

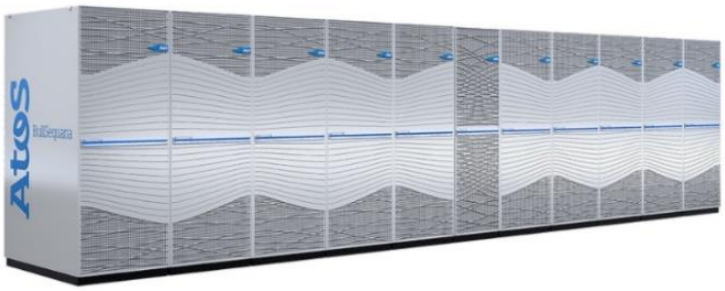
Below are the technical specifications of the procured petascale and precursor to exascale supercomputers.

LUMI

LUMI is a Cray EX supercomputer supplied by Hewlett Packard Enterprise (HPE) and located in Finland. The first phase of the system installation has been completed with the delivery of the CPU only partition, LUMI-C. The installation of the GPU partition, called LUMI-G, is currently ongoing and expected to go operational in Q3 2022. Once installed LUMI will be the most powerful system in Europe, and one of the most powerful in the world, able to deliver ~400 PFlops of sustained aggregated performance.

Sustained performance:	375 petaflops (commited)
Peak performance:	552 petaflops
Compute partitions:	GPU partition (LUMI-G), x86 CPU-partition (LUMI-C), data analytics partition (LUMI-D), container cloud partition (LUMI-K)
Central Processing Unit (CPU):	LUMI-C partition: 3rd generation AMD EPYC™ CPUs 64-core, LUMI-G partition: AMD Trento 64-core
Graphics Processing Unit (GPU):	LUMI-G partition will incoroporate 10,240 AMD MI250X GPUs
Storage capacity:	LUMI's storage system will consist of three components. First, there will be a 7-petabyte partition of ultra-fast flash storage, combined with a more traditional 80-petabyte capacity storage, based on the Lustre parallel filesystem, as well as a data management service, based on Ceph and being 30 petabytes in volume. In total, LUMI will have a storage of 117 petabytes and a maximum I/O bandwidth of 2 terabytes per second
Applications:	AI, especially deep learning, and traditional large scale simulations combined with massive scale data analytics in solving one research problem
Other details:	LUMI takes over 150m2 of space, which is about the size of a tennis court. The weight of the system is nearly 150 000 kilograms (150 metric tons). LUMI will use renewable electricity and its waste heat will account for about 20 percent of the district heating in Kajaani and will reduce the entire city's carbon footprint. Overall the LUMI project aligns the Digital and Green Deal policies of the EC relying on 100% renewable carbon neutral energy.

LEONARDO

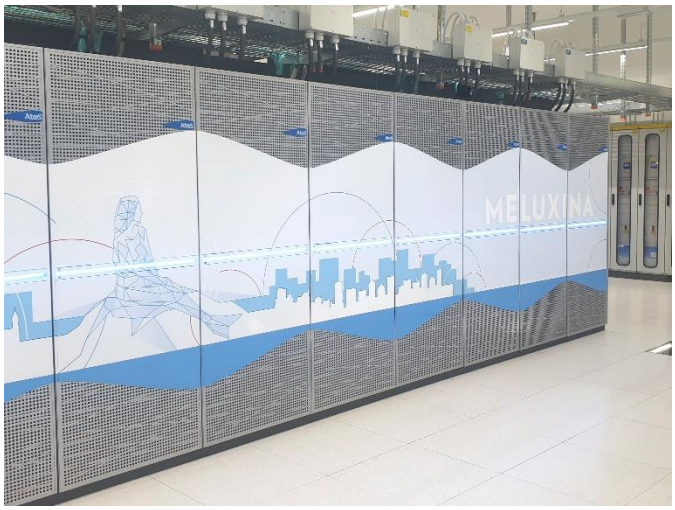


Leonardo is supplied by ATOS, based on a BullSequana XH2000 supercomputer and located in Italy. Once operational, Leonardo will be one of the fastest Artificial Intelligence (AI) Supercomputers in the world, delivering 10 exaflops of FP16 AI performance.

Sustained performance:	249.4 petaflops (commited)
Peak performance:	322.6 petaflops
Compute partitions:	Booster, hybrid CPU-GPU module delivering 240 PFlops, Data-Centric, delivering 9 Pflops and featuring DDR5 Memory and local NVM for data analysis
Central Processing Unit (CPU):	Intel Ice-Lake (Booster partition), Intel Sapphire Rapids (Data-centric partition)
Graphics Processing Unit (GPU):	NVIDIA Ampere architecture-based GPUs, delivering 10 exaflops of FP16 Tensor Flow AI performance
Storage capacity :	Leonardo is equipped with over 100 petabytes of state-of-the-art storage capacity and 5PB of High Performance storage
Applications:	The system targets: modular computing, scalable computing applications, data-analysis computing applications, visualization applications and interactive computing applications, urgent and cloud computing
Other details:	Leonardo will be hosted in the premises of the Tecnopolo di Bologna. The area devoted to the EuroHPC Leonardo system includes 890 sqm of data hall, 350 sqm of data storage, electrical and cooling and ventilation systems, offices and ancillary spaces

MELUXINA

MeluXina is an Atos BullSequana XH2000 supercomputer, installed in Luxembourg. The system implements a modular architecture, offering multiple partitions incorporating different technologies to satisfy most of the processing requirements of scientific and industrial HPC applications. MeluXina is the most powerful of the EuroHPC petascale supercomputers with an aggregated performance of 12.81 petaflops. When announced in June 2021, it was listed in #36 of Top500 and #4 in Green500 making it the most energy efficient system in the EU.



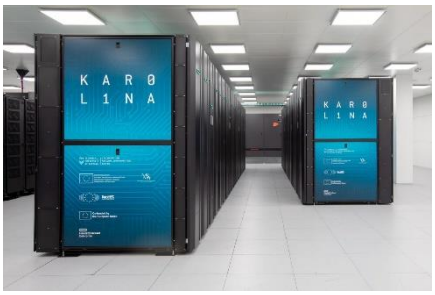
Sustained performance:	12.8 Petaflops
Peak performance:	Expected 15+ petaflops HPL and ~500 petaflops AI (Accelerator - GPU Module), 3+ petaflops HPL (Cluster Module)
Compute partitions:	Cluster, Accelerator - GPU, Accelerator - FPGA, Large Memory
Central Processing Unit (CPU):	AMD EPYC Rome
Graphics Processing Unit (GPU):	NVIDIA Ampere A100 GPUs
Storage capacity:	20 petabytes main storage with an all-flash scratch tier at 400GB/s, and a 5 petabytes tape library expandable to 100 petabytes
Applications:	Traditional Computational, AI and Big Data/HPDA workloads
Other details:	Modular Supercomputer Architecture with a Cloud Module for complex use cases and persistent services, an aggregated 476TB RAM, Infiniband HDR interconnect in Dragonfly+ topology, high speed links to the GÉANT network and Public Internet

VEGA

Vega, was the first supercomputer to become operational. It is an Atos BullSequana XH2000 supercomputer, located in Slovenia. It comprises mainly of two partitions: the first offering CPU only processing and the second providing GPU capabilities. Vega CPU was listed in #106 and Vega GPU in #134, in the June 2021 edition of Top500 list.

Sustained performance:	6,9 petaflops
Peak performance:	10,1 petaflops
Compute partitions:	CPU partition: 960 nodes, 256GB memory/node, 20% double memory, HDR100 & GPU partition: 60 nodes, HDR200
Central Processing Unit (CPU):	122.800 cores, 1920 CPUs, AMD Epyc 7H12
Graphics Processing Unit (GPU):	240 Nvidia A100 GPUs
Storage capacity:	High-performance NVMe Lustre (1PB), large-capacity Ceph (23PB)
Applications:	Traditional Computational, AI, Big Data/HPDA, Large-scale data processing
Other details:	Wide bandwidth for data transfers to other national and international computing centres (up to 500 Gbit/s). Data processing throughput 400GB/s from high-performance storage and 200Gb/s from large capacity storage

KAROLINA



Karolina is built by Hewlett Packard Enterprise (HPE) and based on an HPE Apollo 2000Gen10 Plus and a HPE Apollo 6500 partition.

Sustained performance:	9,59 petaflops
Peak performance:	15.2 petaflops
Compute partitions:	The supercomputer consists of 6 main parts: • a universal part for standard numerical simulations, which will consist of approximately 720 computer servers with a theoretical peak performance of 3.8 PFlop/s, • an accelerated part with 72 servers and each of them being equipped with 8 GPU accelerators providing a performance of 11 PFlop/s for standard HPC simulations and up to 150 PFlop/s for artificial intelligence computations, • a part designated for large dataset processing that will provide a shared memory of as high as 24 TB, and a performance of 74 TFlop/s, • 36 servers with a performance of 131 TFlop/s will be dedicated for providing cloud services, • a high-speed network to connect all parts as well as individual servers at a speed of up to 200 Gb/s, • data storages that will provide space for more than 1 PB of user data and will also include high-speed data storage with a speed of 1 TB/s for simulations as well as computations in the fields of advanced data analysis and artificial intelligence.
Central Processing Unit (CPU):	More than 100,000 CPU cores and 250 TB of RAM
Graphics Processing Unit (GPU):	More than 3.8 million CUDA cores / 240,000 tensor cores of NVIDIA A100 Tensor Core GPU accelerators with a total of 22.4 TB of superfast HBM2 memory
Storage capacity:	More than 1 petabyte of user data with high-speed data storage with a speed of 1 TB/s
Applications:	Traditional Computational , AI, Big Data

DISCOVERER

Discoverer is a BullSequana XH2000 supercomputer, located in Sofia, Bulgaria. It comprises of a single CPU-based partition offering 4.5 Petaflops of sustained performance. Compared to the rest of the EuroHPC petascale systems, it offers the largest and most powerful CPU-only partition and is an excellent platform for traditional computational applications that do not benefit from GPU accelerators.

Sustained performance:	4,52 petaflops
Peak performance:	6 petaflops
Compute partitions:	One partition providing 1128 nodes
Central Processing Unit (CPU):	AMD EPYC “Rome” 7H12 64core
Graphics Processing Unit (GPU):	No
Storage capacity:	2 petabytes
Applications:	Traditional Computational
Other details:	Topology - Dragonfly+ with 200Gbps (IB HDR) bandwidth per link

DEUCALION

Deucalion supercomputer is supplied by Fujitsu and will be located in Portugal. It combines a Fujitsu PRIMEHPC (ARM partition) and Atos Bull Sequana (x86 partitions). The PRIMEHPC partition is based on the similar architecture like Fugaku in Japan, which is currently the most powerful supercomputer in the world.

Sustained performance:	7,22 petaflops (committed)
Peak performance:	10 petaflops
Compute partitions:	ARM Partition: 1632 nodes, 3.8 PFLops ; x86 Partition: 500 nodes, 1,62 PFLops ; Accelerated: 33 nodes, 1,72 PFLops
Central Processing Unit (CPU):	A64FX (ARM partition), AMD EPYC (x86 partitions)
Graphics Processing Unit (GPU):	NVidia Ampere

Storage capacity:	430 TB High-speed NVMe partition, 10.6 PB high-speed based Parallel File System partition.
Applications:	Traditional Computational, AI, Big Data
Other details:	Deucalion will be installed at the Portuguese Foundation for Science and Technology (FCT) Minho Advanced Computing Centre (MACC), in close collaboration with the municipality of Guimarães, in the North of Portugal, as part of a fully sustainable computing infrastructure aiming at promoting new advancements in the digital and green transitions

Lenovo versus EuroHPC JU action (European Court of Justice)

On December 2020, Lenovo Global Technology Belgium brought a legal action before the General Court of the European Union against EuroHPC JU (Case T-717/20) for the annulment of the Decision of the EuroHPC JU of 29 September 2020, concerning the procedure for the acquisition, delivery, installation and hardware and software maintenance of Precursors to Exascale Supercomputers for the EuroHPC JU -SMART 2019/1084 -Lot 3: Leonardo. At the end of 2021, the legal process was still on-going.

Hyper connectivity for HPC Resources

In line with the new EuroHPC JU Regulation, Annual Work Plan 2021 introduced a preparatory activity to identify the concrete needs, evolution over time and implementation mode, to define the specifications of the call to efficiently implement this action. The ongoing and planned developments in the petascale, pre-exascale, quantum and exascale pan-European HPC infrastructure, coupled with the federation of a variety of digital resources and services, will lead to a considerable increase in data traffic. In order to guarantee the necessary cross border capacity of the network infrastructures interconnecting HPC centres, and eventually the data centres (e.g. EuroHPC JU hosting entities, National HPC Tier-0/1 centres, EU research data centres, EU data spaces, …), the network capacity needs to be enhanced progressively to provide and ensure the required high-speed links to access the HPC resources, in synch with the increase of data traffic. A budget of EUR 100 million has been allocated to this activity and the development of this call is currently under discussion.

Other procurement procedures managed by EuroHPC-JU in 2021

At the end of 2020, a negotiation procedure for low value contracts for the supply of services in the field of audits and controls (Audit of the annual accounts of the EuroHPC JU for the years

ended 31/12/2020 and 31/12/2021) was launched. After the evaluation phase, the contract was awarded to EY Réviseurs d'Entreprises / EY Bedrijfsrevisoren in January 2021.

At the beginning of 2021, a negotiation procedure without prior publication of a contract notice for the legal representation of EuroHPC JU before the Court of Justice in the Case T-717/20 (Lenovo Belgium vs EuroHPC JU) was launched. The contract was awarded to Arendt in February 2021.

In July 2021, a negotiation procedure for low value contracts for the supply of data protection services (EU data protection online Central Register and data protection gap analysis services) was launched. After the evaluation phase the contract was awarded to Crowell & Moring LLP in November 2021.

On 28 May 2021, by Governing Board Decision No 10/2021, the public procurement procedure for the acquisition, delivery, installation and maintenance of Supercomputer MareNostrum 5 for Hosting Entity Barcelona Supercomputer Centre (competitive dialogue process published via eTendering in November 2019, SMART 2019/1084, Lot 2), was cancelled.

On 1 December 2021, by Governing Board Decision No 12/2021, the launching of the call for tenders for the acquisition of MareNostrum 5 Precursor to Exascale Supercomputer was approved. The relevant open procurement procedure was published in eTendering on 3 December 2021.

1.3. OPERATIONAL BUDGET EXECUTION

The EuroHPC JU budget revenue according to the final voted budget for 2021 is EUR 207.5 million. The cashed amount in 2021 including the cashed amount from 2020 was EUR 164.5 million.

- The contributions received from CSC (Finland) and CINECA (Italy) Hosting Entities (HE) include the financial contributions made by the EuroHPC JU Participating States. This contribution amounts to EUR 48,4 million for the pre-exascale supercomputers. Recovery of these financial contributions is done through the Hosting Entities which, for these procurements, act on behalf the Participating States. One Recovery Order was launched in 2020 but the amount was only cashed in 2021 (LUMI: ca. EUR 12 million).

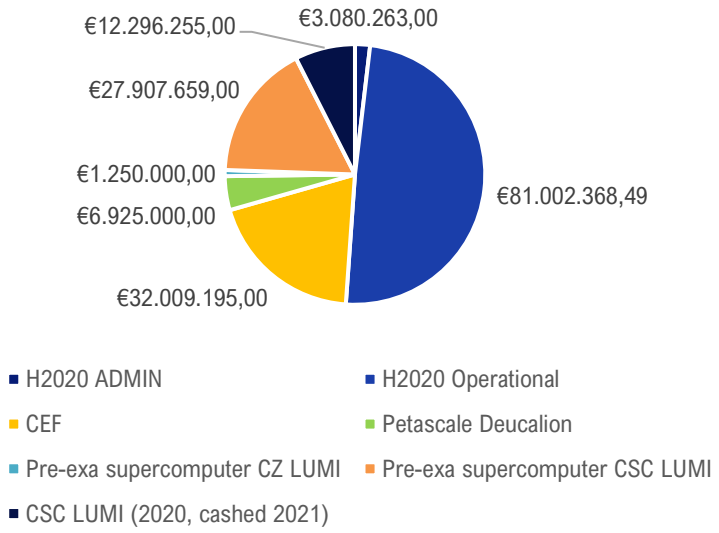
- The EU contribution received amounts to EUR 116,1 million.

- Due to contractual penalties because of the late delivery of EUROIT4I SUPERCOMPUTER (Karolina), an additional amount of EUR 34.665,60 is included in the revenue which was not foreseen and accounted for in the budget 2021. Therefore the total revenue amount is EUR 164,5 million .

- The recovery order for Leonardo was launched at the end of 2021 and is not shown in the above table as it was not cashed in 2021, therefore this amount (ca. EUR 55 million) is currently not reflected.

The table below shows in detail the contributions cashed in 2021 from the EU and Participating States.

Contributions from EU and Participating States



Contributions from EU and Participating States			
EU H2020 ADMIN	3.080.263,00 €		
EU H2020 Operational	81.002.368,49 €		
EU CEF	32.009.195,00 €	116.091.826,49 €	70,59%
PS Petascale Deucalion	6.925.000,00 €		
PS Pre-exa supercomputer CZ LUMI	1.250.000,00 €		
PS Pre-exa supercomputer CSC LUMI	27.907.659,00 €		
PS CSC LUMI (2020, cashed 2021)	12.296.255,00 €	48.378.914,00 €	29,41%
	164.470.740,49 €		

1.3.1. Expenditure under Title 1 and 2

The EuroHPC JU did not use all commitment and payment appropriations reserved on administrative lines.

- Staff costs increased during 2021 thanks to the newly recruited staff (15 at the end of 2021 + interim agents). Due to the Covid pandemic, only limited staff missions were permitted, which explains the underconsumption of this budget line.

- Due to the Covid pandemic only one hybrid meeting of the Governing Board was organised in Luxembourg. As a result, only 29.04 % under Title 2 was committed. The outstanding credits will be reactivated in 2022.

- 64.91 % of payment appropriations under Title 1 was consumed and 24.21 % under Title 2. This underspending is clearly linked to the COVID pandemic. The remaining funds will be reactivated in 2022.

- The JU has given priority to spending the C2 (reactivated credits), therefore the implementing rate of the C1 credits is a bit lower.

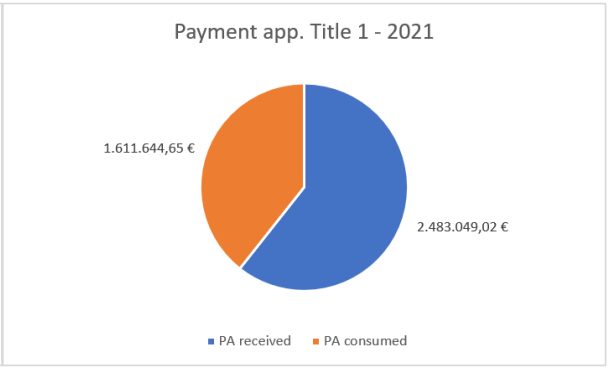
- Lastly, the JU is working with DG BUDG to clarify the situation on JU staff pension contributions, in line with the recommendations of the European Court of Auditors made in late 2021.

Budget implementation under title 1 and 2 (Administrative Expenses C1 and C2 appropriations) is as follows:

Description	Comm.Credits	Comm.Cons.	Comm.Credits Avail.	Pay.Credits	Pay.Cons.	Pay.Credits Avail.
title 1	2.478.297,92 €	1.840.902,97 €	637.394,95 €	2.483.049,02 €	1.611.644,65 €	871.404,37 €
		74,28%			**64,91%**	
title 2	2.724.244,91 €	791.147,40 €	1.933.097,51 €	2.776.274,53 €	672.185,56 €	2.104.088,97 €
		29,04%			**24,21%**	
total Title 1 and 2	5.202.542,83 €	2.632.050,37 €	2.570.492,46 €	5.259.323,55 €	2.283.830,21 €	2.975.493,34 €
		50,59%			**43,42%**	

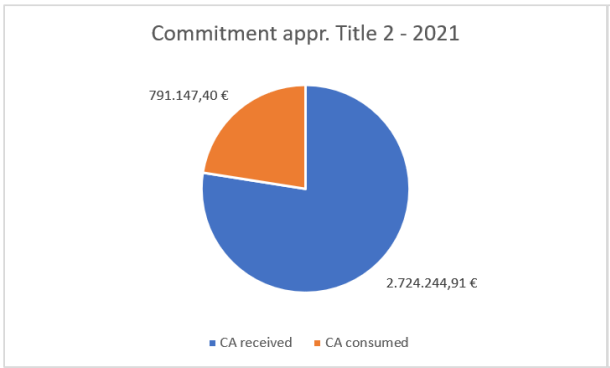
Situation of commitment and payment appropriatons Title 1

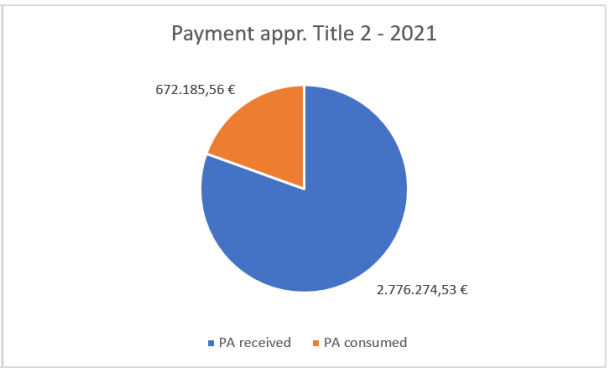
Commitment appropriations		Payment appropriations	
CA received	2.478.297,92 €	PA received	2.483.049,02 €
CA consumed	1.840.902,97 €	PA consumed	1.611.644,65 €
	74,28%		64,91%



Situation of commitment and payment appropriatons Title 2

Commitment appropriations		Payment appropriations	
CA received	2.724.244,91 €	PA received	2.776.274,53 €
CA consumed	791.147,40 €	PA consumed	672.185,56 €
	29,04%		24,21%





In line with the Joint Undertaking N+3 rule, unused appropriations will be carried over to 2022. The tables above show the C1 and C2 appropriations.

1.3.2. Expenditure under Title 3

EuroHPC JU signed almost all legal commitments foreseen in Work Plan 2021. The JU spent most of the year managing the delivery of procured supercomputers with the JU's partners. This has been challenging because of both the pandemic and supply chain issues. However, four supercomputers (Vega, Meluxina, Discoverer and Karolina) have been delivered and are operational.

The JU is now working with our partners to finalise delivery of the following supercomputers :

- Due to delays in the global supply chain, Meluxina, which is operational, only got a partial acceptance, and thus the JU only paid for the completed work. Once this supply issue is resolved, the rest of the payments will be made.
- For LUMI we have paid the acquisition in part and we have recovered the respective contributions. Due to delay in global supply of chips, the JU only paid for completed work. Again, a further payment is planned when the system is fully operational.
- For Leonardo, substantial delays occurred in the supply of the system and the building of the data centre, and therefore the payment was only executed partially. With regards to the Deucalion, the system is ready to be installed and awaiting the completion of the data centre which is expected in 2022 (when final payment will also take place).
- Lastly, the JU relaunched in December 2021, with the same H2020 commitment, the procurement of the Mare Nostrum 5 (MN5) supercomputer which cancelled because of changes in requirements due to the COVID pandemic.

The EUMaster4HPC Grant Agreement was signed in May 2022.

Regarding the underspending of payment appropriations on the R&I calls in 2021, the pre-financing payments executed for the grants under the calls launched in 2020 were lower than first estimated in the early days of the JU in 2020. In addition, the interim payment request MareNostrum 5 Operating Grant was delayed due to the relaunch of the MareNostrum 5 Supercomputer procurement. (see above). The foreseen interim payments for Castiel, EuroCC and Meep were requested towards the end of the year and were paid within the foreseen payment delay only at the beginning of 2022.

At the end of 2021, the Work Programme 2021 was amended to include tasks introduced by the new regulation with additional commitment credits amounting to 719,4 MEUR) and which will only be consumed in 2022 (procurement of exascale and mid-range HPCs, hyperconnectivity infrastructure and quantum computing).

Budget implementation under title 3 (Grants and Infrastructure C1 and C2 appropriations) is as follows:

Situation of commitment and payment appropriatons Title 3 in 2021

Commitment appropriations		**Payment appropriations**	
CA received	748.199.276,01 €	PA received	342.986.546,29 €
CA consumed	9.647.177,98 €	PA consumed	162.330.830,75 €
	1,29%		47,33%

The first JU Work plan and Budget 2021 was voted in December 2020, three months after autonomy in September 2020. This budget took into account all legacy H2020 calls that had not been launched before autonomy and were further delayed due to lack of staff and of course the COVID pandemic.

Work Plan and Budget 2021 was then amended one final time in December 2021 to take into account new tasks from Regulation 2021/1173 and new MFF funding such as the exascale and mid-range Hosting entity call and other associated commitments .

1.3.3. In-kind contributions

Participation states reported on their contributions for operational activities in 2021. The EuroHPC JU secretariat is currently working with its two 2021 private members - the ETP4HPC and DAIRO (BDVA) – to establish a reporting mechanism for the membership of these two associations.

FY2021	In-kind contributions in operating costs Pre-ExaScale	Acquistion Infrastructure Pre-ExaScale	Acquisition Infrastrusture Petascale	Indirect Actions R&I (PSs Financial Contributions)
No	5.939.833,97 €			- €
Yes	6.694.517,64 €	6.000.000,00 €	6.925.000,00 €	7.390.895,60 €
Grand Total	**12.634.351,61 €**	**6.000.000,00 €**	**6.925.000,00 €**	**7.390.895,60 €**

FY2021	In-kind contributions by the Private Members
DAIRO	63.120,57 €
ETP4HPC	1.962.360,30 €
Grand Total	**2.025.480,87 €**

Participating States & Private Member contributions	FY 2021 - amounts in Euro
Financial Contributions (Acquisition Petascale + Indirect Actions)	20.315.895,60 €
Total IKOP (PS and private members	14.659.832,47 €
Total to report in the annual Accounts	**14.659.832,47 €**
Total to report in the AAR 2021	**22.050.728,07 €**

Financial contribution of 6 Mio Euro reported from PSs for the acquisition of the Pre Exa-scale supercomputers and 6,9 Mio for Deucalion petascale supercomputer are incuded in EHPC revenues, so no needs te report in AAR2021.

2. SUPPORT TO OPERATIONS

2.1. COMMUNICATION ACTIVITIES

Since its autonomy in September 2020, the EuroHPC JU has undertaken a number of communication actions to start building its public image and throughout 2021, communications activities continued to ensure public awareness about the EuroHPC JU's activities. 2021 being the first full year as an autonomous Joint Undertaking, communication activities continued to foster awareness with EU and national policy makers, as well as stakeholders of the High Performance Computing Sector. Due to the ongoing Covid-19 pandemic, communication activities were largely restricted to virtual and online presence.

Despite this, the JU has taken the opportunity to participate in many different events, virtual and in-person, addressing various audiences : researchers, policy-makers, enterprises, students to present the JU and raise awareness about its actions and achievements.

Figure 4: Executive Director Anders Dam Jensen speaks at the Meluxina Inauguration in Luxembourg.
Copyright: SIP / Jean-Christophe Verhaegen

2021 also saw the inauguration ceremonies of three supercomputers: Vega in Slovenia (April 2021), Meluxina in Luxembourg (June 2021) and Discoverer in Bulgaria (October 2021). Each inauguration is reported on the JU's website and promoted on social media channels.

In May 2021, the JU inaugurated its Headquarters in Luxembourg. The event was streamed online and was attended by Ministers Asselborg and Fayot from Luxembourg and Commissioner Thierry Breton.

Throughout the year, the EuroHPC JU and its supercomputers earned various awards: EuroHPC supercomputer MeluXina was named Europe's greenest computer and 4th greenest in the world in the June edition of the Green500 list, and LUMI was highly ranked both for its green credentials and its power on the TOP500 and Green500 in November. The EuroHPC JU also won HPC Wire's Editor's Choice Award for Best HPC Collaboration.

Multiple projects were announced during 2021, including the new pan-European Masters Programme lead by the University of Luxembourg. The Masters Programme will continue to be an opportunity to share and communicate in the future, as the first students join the

programme and graduate from it over the next few years. Each new project is an opportunity to engage and communicate with the project participants and the broader HPC community.

In September, EuroHPC JU celebrated its first full year of autonomy, which was an opportunity to look back and share all that had been achieved in the first year.

The JU has developed a website https://eurohpc-ju.europa.eu presenting the JU, its various actions and providing up to date information to the general public, its stakeholders and its members. Over the last year, the JU has continuously improved the platform in coordination with the Directorate-General for Informatics of the European Commission (DIGIT). More precisely and since September 2020 and throughout 2021, the communication team of the JU has published on its website:

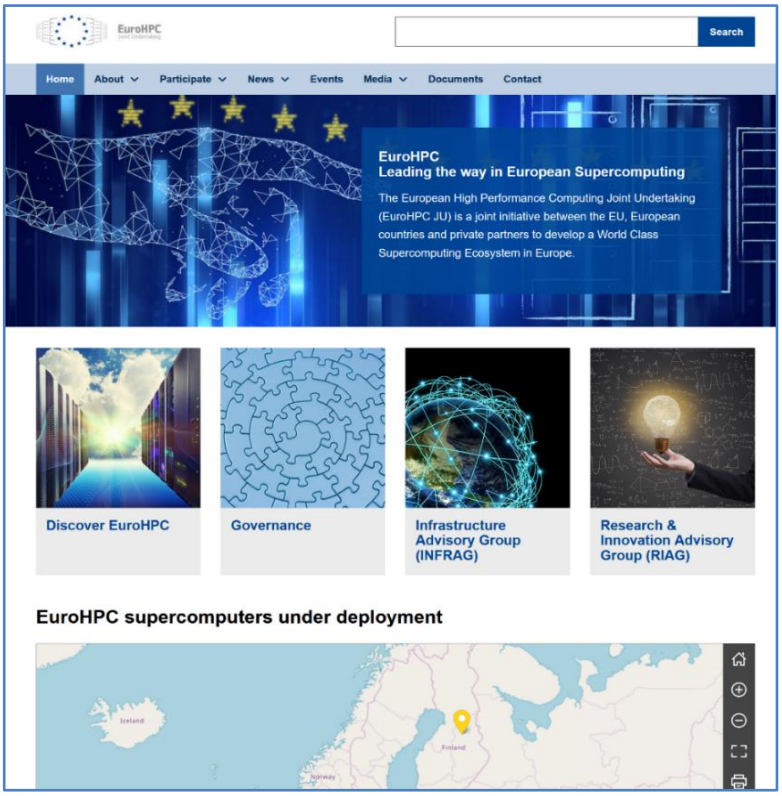


Figure 6 5: The EuroHPC website

- 36 press releases announcing key actions and milestones like inauguration of EuroHPC supercomputers, kick-off of new R&I projects, opening of calls and various important announcements;
- 10 calls: calls for expression of interest for the selection of the Hosting Entities (HE), calls for procurements of HPC machines, R&I calls, calls for experts, calls for regular access to the EuroHPC supercomputers and calls for administrative procurements;
- 7 supercomputers descriptions presenting the characteristics of each system;
- 30 project descriptions presenting the R&I ongoing projects of the JU;
- 70 documents providing details on the JU activities like decisions of the Governing Board (GB), summaries of the GB meetings, yearly work plans, EuroHPC systems report, and Annual Activities reports (AAR);
- 13 videos and 8 pictures presenting the achievements of the JU in an interactive manner.

During that period, the JU has also increased its presence on Social Media. On Twitter @EuroHPC_JU and LinkedIn EuroHPC Joint Undertaking, the JU has built a constantly growing stakeholder community. The current Twitter and LinkedIn followings at time of writing is 2,109

and 2,182 followers respectively. Both followings have significantly increased since the end of 2020, as a result of meaningful and consistent daily posts and regular engagement with its community. Through these channels, the communication team of the JU promotes its press releases, calls, announcements and participation in events.

In addition the JU has recently launched its own YouTube EuroHPC JU channel showcasing videos on its supercomputers and its R&I projects.

In September 2021, the JU has set up a monthly EuroHPC JU's Digest sent to its GB and relevant partners and reviewing European HPC, projects, and supercomputer news from the past month.

Over the last year the JU has answered various media queries, given several interviews and started to create its own network of journalists.

2.2. LEGAL AND FINANCIAL FRAMEWORK

The legal framework refers to:

- Council Regulation (EC) 2018/1488 of 28 September 2018;
- As of 8th August 2021: The new basic EuroHPC JU legal Act: Council Regulation (EU) 2021/1173 of 13 July 2021
- The Horizon 2020 Regulation (EU) 1291/2013 and its Rules for Participation:
- New framework programmers which provided funding in 2021: (EU) 2021/695 of The European Parliament and of The Council of 28 April 2021 establishing Horizon Europe;
- The CEF Regulation (EU) 1290/2013
- As of 2021, Regulation (EU) 2021/1153 of the European Parliament and of the Council of 7 July 2021 establishing the Connecting Europe Facility;
- The new Digital Europe Programme 2021-2027, established by Regulation (EU) 2021/694 of the European Parliament and of the Council of 29 April 2021;
- The Financial Rules adopted by the Governing Board on 20 February 2020 and re-adopted in first GB under the new council regulation 30th September 2021

The financial framework is set by the Commission Decision C(2019)5357 and its annexes.

2.3. BUDGETARY AND FINANCIAL MANAGEMENT

The Financial Rules establishes that the Accounting Officer shall be independent in the performance of his or her duties, enforcing an effective separation of duties between this position and that of Authorising Officer. In 2020, the EuroHPC JU agreed with the Commission to nominate the Commission Accounting Officer as Accounting Officer for the EuroHPC JU and this was continued in 2021.

The budget of the EuroHPC JU is divided into 3 titles as follows:

- Title 1: Staff expenditure
- Title 2: Other administrative expenditure
- Title 3: Operational expenditure Procurement and contracts

2.4. PROCUREMENT AND CONTRACTS

List of contracts awarded:

- Office Supplies
- IT Equipment
- Communications Services

2.5. IT AND LOGISTICS

- Implementation of ABAC assets
- Support of new staff with IT equipment
- Investment in security and SLA for cybersecurity

2.6. HUMAN RESOURCES

After the growth of the JU team in 2020, 3 further recruitments were made in 2021:

- 1 Human Resources Officer
- 1 Budget Officer
- 1 Legal Officer

At the end of 2021, the JU employed 15 statutory staff and 3 Interim staff who assist the Finance and Communications team. As the SNE post allocation was discontinued under the new

Regulation, the recruitment was put on hold and will be replaced by the recruitment of a Programme Officer in 2022.

The Organisational Chart (see annex 1) and staff establishment plan (see annex 2) gives an overview and forecast of annual staff positions for the period 2021-2027. It takes into account the new Council Regulation of 2021/1173 of 13 July 2021 establishing EuroHPC JU and repealing the Regulation of 2018. The estimation of the cost of human resources is based on the total average cost.

At the end of 2021, 7 further vacancies were published and recruitment for these positions took place in the first half of 2022[8]. Given that the establishment plan was only be adopted in December 2021 by the Governing Board, new recruitment procedures will only be finalised in 2022. Moreover, even though the new regulation foresees the allocation of 34 posts to the JU, budgetary credits will only be available in 2022.

Based on the comments received from the European Court of Auditors in their 2020 audit and the needs assessment made by the JU, priority was given to posts ensuring business continuity of critical JU functions in each pillar of JU's activity. The first selections will therefore focus on the following posts: HR Assistant, Programme Officers, IT Officer, Internal Control & Audit, Financial Assistant and Procurement Officer.

With the entry into force of the new Regulation, the main focus of the Human Resources will be on the recruitment and integration a diverse group of individuals (both in terms of nationality and gender) who are willing to work and live in Luxembourg.

Integration of newcomers to the team, as well as enhancing team cohesion within new re-organised JU will be a priority. In view of the future growth, the organisation needs a solid structure, in order to ensure both the efficiency and effectiveness of its operations. The implementation of the HR tools, policies and procedures, in line with the Implementing Rules adopted by the Governing Board will continue.

Effort will be made to strengthen the existing and develop new competencies. As the team grows, relevant training offer will be determined for different groups of staff. Efforts will also be made to stimulate interaction and knowledge sharing between colleagues, as well as maintain good team spirit.

[8] See Annex 1: Organisational Chart

Human resources planning for the period of 2021-2027, under the new Regulation:

	2021 Reg 2018/1488	2021/2022 Reg 2021/1173	2022	2023	2024	2025	2026	2027
Establishment plan posts: TA	4	14	22	27	27	27	27	27
Total establishment plan posts	4	14	22	27	27	27	27	27
Contract Agents	11	20	25	30	30	30	30	30
Seconded National Experts	1	0	0	0	0	0	0	0
Total Staff	16	34	47	57	57	57	57	57

Breakdown of Temporary Staff by grade

CATEGORY AND GRADE	2021 TA	2022 TA
AD 16		
AD 15		
AD 14	1	1
AD 13		
AD 12		1
AD 11		

AD 10	1	2
AD 9		
AD 8	2	6
AD 7		10
AD 6		1
AD 5		
Total AD	4	21
AST 4		1
Total AST/SC		1
TOTAL	4	22

Breakdown of external staff by Function Group

External Personnel – Contract Agents	2021	2022
Function Group IV	5	9
Function Group III	4	13
Function Group II	2	3
SNE	1	0
Total Staff	12	25

3. GOVERNANCE

3.1. GOVERNING BOARD

The Governing Board met online very regularly in 2021.

The new Regulation entered into force on 8 August 2021 (Article 40 of the Regulation), and the first Government Board meeting since the Regulation came into force took place on 30 September 2021.

In September 2021, the Governing Board re-adopted a number of Decisions, including the Rules of Procedures. This in line with Article 39.4 of the new Regulation that provides that at its first meeting after the entry into force of this Regulation, the Governing Board shall adopt a list of decisions adopted under Regulation (EU) 2018/1488 that shall continue to apply under this Regulation.

Some of the provisions of the Governing Board Rules of Procedure adopted by Decision 1/2018 were updated to take into account the new Regulation in order to avoid inconsistencies and discrepancies with the Regulation.

The new Governing Board then elected Dr Herbert Zeisel unanimously as its Chair for 2 years. This Governing Board meeting was the only one that took place physically in 2021.

Membership of the Governing Board also evolved (see annex 5 for list of members at the end of 2021). Third countries that have not signed Horizon Europe programme association agreements are not considered Participation States. This led to the departure of the Swiss Confederation from the JU. However, they are still involved in co-funding H2020 EuroHPC activities and LUMI supercomputer consortium.

3.2. EXECUTIVE DIRECTOR

The Executive Director is the legal representative and the chief executive for the day-to-day management of the EuroHPC JU, in accordance with the decisions of the Governing Board, in line with the Statutes.

The vacancy for the post of the Executive Director was published on 17 May 2019 with a deadline for applications of 19 June 2019. The Executive Director, Anders Dam Jensen, was appointed on 15 May 2020 and took office on 16 September 2020, a week before the EuroHPC JU became autonomous.

3.3. INDUSTRIAL AND SCIENTIFIC ADVISORY BOARD

The Industrial and Scientific Advisory Board consists of the Research and Innovation Advisory Group (RIAG) and the Infrastructure Advisory Group (INFRAG), which provide independent advice to the Governing Board on the strategic research and innovation agenda and on the acquisition and operation of the supercomputers owned by the Joint Undertaking.

RIAG is chaired by Jean-Pierre Panziera, Chief Technology Director for High Performance Computing at Atos. He is also the current Chairman of ETP4HPC, the European Technology Platform for High Performance Computing. The vice-chair is Prof Dr Dr Thomas Lippert, Director of the Julich Forschungszentrum RIAG is composed of 12 members, where no more than six are appointed by the EuroHPC Private Members, taking into account their commitments to the Joint Undertaking, and no more than six are appointed by the Governing Board. In addition, the Governing Board appoints 8 observers, while the Private Members nominate 2 observers. This Advisory Group draws up and regularly updates the draft multiannual strategic research and innovation agenda. This draft multiannual strategic research and innovation agenda shall identify research and innovation priorities for the development and adoption of technologies and key competences for High-Performance Computing across different application areas in order to support the development of an integrated High-Performance Computing ecosystem in the EU, strengthen competitiveness and help create new markets and societal applications.

INFRAG is chaired by Dr Claus Axel Müller, Director of Gauss Centre for Supercomputing, Germany. The vice chair is Sinéad M. Ryan, Professor of Theoretical High-Energy Physics and Head of the School of Mathematics at Trinity College Dublin. It is composed of 12 members appointed by the Governing Board. In addition, the Governing Board appoints 8 observers. This Advisory Group provides advice to the Governing Board for the acquisition and operation of the petascale and pre-exascale supercomputers, drawing up and regularly updating the draft multiannual strategic agenda for such acquisition.

With the adoption of the new Council Regulation in 2021, the new Industrial and Scientific Advisory Board will be appointed. This process will be completed in 2022.

4. INTERNAL CONTROL FRAMEWORK

Internal control activities remain an ongoing exercise in 2021.

In June 2020, the Governing Board adopted the EuroHPC JU Internal Control Framework (ICF). The new framework is based on the revised European Commission framework and consists of five internal control components and 17 principles, based on the COSO 2013 Internal Control-Integrated Framework (a framework for designing, implementing, and conducting internal control).

The internal control activities[9] underpin the structure of the ICF and supports the EuroHPC JU in its efforts to achieve its objectives. To facilitate the implementation of the ICF and management's assessment of whether each component is present and functioning, and whether the components function well together, each component consists of a set of principles. Assessments based on these principles helps to provide reasonable assurance that the EuroHPC JU's objectives are being met. The principles specify the actions required for internal control to be effective.

The characteristics of each principle are defined to assist management in implementing internal control procedures and in assessing whether the principles are functioning and being adhered to.

To be able to implement these 17 principles, the Governing Board also adopted an action plan with detailed measures to be applied in the first years of autonomy and to develop the relevant procedures and processes.

4.1. FINANCIAL PROCEDURES

The manual of EuroHPC Financial Procedures is under preparation. The main purpose of the document is to describe the financial circuits for the implementation of the EuroHPC JU budget. The financial circuits concern the financial operations taking into account the structure of EuroHPC JU and the risks associated with the management environment and the nature of the financing operation. They are established in order to standardise the mandatory steps of the processing of financial transactions and to clarify who the different actors are.

This manual shall be prepared in line with Article 20(4) of the Financial Rules of the EuroHPC JU which states that: 'The Executive Director shall put in place the organisational structure and the internal control systems suited to the performance of duties of the Executive Director, in

[9] Control environment, risk assessment, control activities, information and communication, and monitoring activities

accordance with the minimum standards or principles adopted by the Governing Board, on the basis of the Internal Control Framework laid down by the Commission for its own departments and having due regard to the risks associated with the management environment and the nature of the actions financed. The establishment of such structure and systems shall be supported by a risk analysis which takes into account their cost-effectiveness and performance considerations.'

While this is an on-going process, some templates, checklists and ARES Workflows are in place to safeguard sound financial management.

4.2. EX ANTE CONTROLS ON OPERATIONAL EXPENDITURE

Ex-ante controls are essential to prevent errors and avoid the need for *ex-post* corrective action. In 2021, the EuroHPC JU continued to apply the provisions of Article 66 of the Financial Regulation and Article 21 of the EuroHPC JU Financial Rules: 'each operation shall be subject at least to an *ex-ante* control relating to the operational and financial aspects of the operation, on the basis of a multiannual control strategy which takes risk into account'.

Therefore, the main objective of *ex-ante* controls is to ascertain that the principles of sound financial management have been applied.

The EuroHPC JU continues to apply well-developed procedures defining the controls to be performed by project and finance officers for every cost claim, invoice, commitment, and payment, taking into account risk-based and cost-effectiveness considerations.

For operational Horizon 2020 expenditure, the processing and recording of transactions in the IT accounting system (ABAC) are mainly performed via the corporate Horizon 2020 IT tools (Sygma/COMPASS), which ensures a high degree of automation, and the controls are embedded in each workflow. For operational procurement expenditure, processing and recording of transactions are undertaken in the IT accounting system (ABAC) and using the dedicated tools (Hermes-Ares-Noncom).

4.3. EX-POST CONTROL OF OPERATIONAL EXPENDITURE AND ERROR RATES IDENTIFIED

As the duration of most EuroHPC JU projects is 3 to 5 years and the JU has not yet concluded any projects, there has not yet been the opportunity to apply any ex-post controls. The

completion of the first projects is expected in 2022, which will allow for the application of ex-post controls.

Horizon Europe and Digital Europe

2021 was the first year of implementation of the Horizon Europe and Digital Europe framework programme. The adoption of the MFF Regulations later than initially planned, delayed the starting of its implementation[10]. By the end of 2021, only a very limited number of payments was executed (none in Euro-HPC JU and only pre-financings in DG R&I).

Consequently, taking into account the absence of relevant expenditure, the low-risk nature of the implemented transactions and the absence of ex-post audit results for grants, no detected error rate can be reported for Horizon Europe and Digital Europe Programme in 2021.

4.4. AUDIT OF THE EUROPEAN COURT OF AUDITORS

In 2021, the EuroHPC JU received its first audit from the European Court of Auditors along with the other JUs. The opinion of the Court was clean in terms of reliability of the accounts 2020 and legality and reliability of the transactions underlying the accounts.

The main concerns identified by the ECA is that the JU has been understaffed. The lack of sufficient statutory staff, has led to increased use of interim staff. This can lead to weaknesses in financial, budgetary and staff management, and may pose risks in terms of continuity of activities, retention of key competences and lack of sufficient internal controls. Under the new regulation, EuroHPC JU is able to take steps to rectify this issue and has initiated the recruitment process while prioritising essential positions which relate to key functions of the JU and risk mitigation, such the Internal Auditor positions.

4.5. INTERNAL AUDIT

The European Commission Internal Audit Service made a first risk assessment of EuroHPC JU activities in 2021 and developed the audit plan for the first audit in 2022 on HR matters.

[10] End 2021, for the R&I family 64 calls for proposal had been fully evaluated and only 19 grant agreements had been signed (3 for DG R&I)

4.6. RISK MANAGEMENT AND CONFLICT OF INTEREST

The EuroHPC JU has developed a comprehensive set of rules and procedures for its staff to have a clear framework in which to work. These rules are effective across the entire governance structure of the JU, and are as follows:

- When joining the Project Management and wider JU team, each staff member agrees to the application of the Staff Regulation and signs a declaration of honour on the management absence of conflicts of interest and confidentiality.
- The EuroHPC JU applies by analogy 'mutatis mutandis' the 'Code of Good Administrative Behaviour for Staff of the European Commission in their Relations with the Public'.
- Conflict of interest procedures are in place for the members of both the EuroHPC JU GB and the advisory bodies.
- Specific measures have been implemented for the prevention and management of conflicts of interest of experts in charge of the evaluation of grant applications and of the review of projects and tenders.

In addition, the EuroHPC adopted and started to implement the common Research Anti-Fraud Strategy. In March 2019, the Common Implementation Centre adopted the revised Strategy (RAFS 2019) and the associated action plan. The implementation of the action plan is monitored through regular meetings of the Fraud and Irregularities in research (FAIR) Committee in which the EuroHPC JU will participate.

Furthermore, for areas of expenditure other than grants, the EuroHPC JU applies *mutatis mutandis* and by analogy, the anti-fraud strategy approved by DG Communications Networks, Content and Technology Risk management (DG CNECT).

This function has been taken over by the JU Team. Staff recruitment is ongoing to be able to ensure that this activity is undertaken in full compliance. The internal control and audit manager is expected to start in early 2022.

4.7. COMPLIANCE AND EFFECTIVENESS OF INTERNAL CONTROL

The EuroHPC JU Governing Board adopted the EuroHPC internal control framework (ICF) in June 2020 and re-adopted the ICF in September 2021 under the new Council Regulation. Additionally, an action plan to implement the Internal Control Principles and related processes and procedures was adopted, with application in the first years of the autonomy of the EuroHPC JU.

The EuroHPC JU ICF is designed to provide reasonable assurance regarding the achievement of the following five objectives:

- Effectiveness, efficiency and economy of operations;
- Reliability of reporting;
- Safeguarding of assets and information;
- Prevention, detection, correction and follow-up of fraud and irregularities;
- Adequate management of the risks relating to the legality and regularity of the underlying transactions.

The ICF is composed of 17 principles which aim at helping the EuroHPC JU to address different types of management issues and risks, so that reasonable assurance regarding the proper execution of the whole operational system has been gained.

Internal Control Principles (ICP) are based on the same principles as applied by the Commission and adapted to the EuroHPC JU's context and specificities. The EuroHPC JU's ICPs provide generic management principles and set out the minimum requirements for EuroHPC JU control activities.

5. MANAGEMENT ASSURANCE

5.1. ASSESSMENT OF THE ANNUAL ACTIVITY REPORT BY THE GOVERNING BOARD

The Executive Director submits the draft Annual Activity Report (AAR) 2021 to the Governing Board for assessment and approval. The Governing Board approves the AAR together with the annual accounts. Once approved by the GB, the AAR is made publicly available. No later than 1 July 2022, the AAR together with its assessment will be sent by the Executive Director to the European Court of Auditors and to the European Commission.

The members of the Governing Board of the EuroHPC Joint Undertaking took note of the Annual Activity Report 2021. The presented document is the second Annual Activity Report of the EuroHPC JU since its autonomy in September 2020. The highlights of the report have been presented during the Governing Board meeting held on 14 June 2022.

The EuroHPC Joint Undertaking was established on 28 September 2018 by Council regulation No 2018/1488, published in the Official Journal of the EU on 8 October 2018 and entered into force on 28 October 2018. Following the adoption of the new Council Regulation 2021/1173 in July 2021, the JU's objectives were updated and now reads as follows:

- to contribute to the implementation of Regulation (EU) 2021/695 and in particular Article 3 thereof, to deliver scientific, economic, environmental, technological and societal impact from the Union's investments in research and innovation, so as to strengthen the scientific and technological bases of the Union, deliver on the Union strategic priorities and contribute to the realisation of Union objectives and policies, and to contribute to tackling global challenges, including the Sustainable Development Goals by following the principles of the United Nations Agenda 2030 and the Paris Agreement adopted under the United Nations Framework Convention on Climate Change;
- to develop close cooperation and ensure coordination with other European Partnerships, including through joint calls, as well as to seek synergies with relevant activities and programmes at Union, national, and regional level, in particular with those supporting the deployment of innovative solutions, education and regional development, where relevant;
- to develop, deploy, extend and maintain in the Union an integrated, demand-oriented and user-driven hyper-connected world-class supercomputing and data infrastructure;
- to federate the hyper-connected supercomputing and data infrastructure and interconnect it with the European data spaces and cloud ecosystem for providing computing and data services to a wide range of public and private users in Europe;

- to promote scientific excellence and support the uptake and systematic use of research and innovation results generated in the Union;
- to further develop and support a highly competitive and innovative supercomputing and data ecosystem broadly distributed in Europe contributing to the scientific and digital leadership of the Union, capable of autonomously producing computing technologies and architectures and their integration on leading computing systems, and advanced applications optimised for these systems;

In consequence of the new mission given by the new council regulation, the new Governing Board was composed and a new chair Dr Herbert Zeisel was elected in October 2021. The composition of RIAG and INFRAG was rearranged due to the updated mission. The MASP and the annual work plans 2021 and 2022 were updated. To this end, 11 Governing Board meetings were held throughout 2021. New Participating States of the Governing Board joined such as Malta and others did not return such as Switzerland.

2021 saw the expansion of the JU's team to 15 staff members, although the JU is still lacking staff and at the end of 2021 is starting a new round of recruitment to hire new staff members in 2022.

The JU received its first European Court of Auditors (ECA) feedback on its budget and accounting 2020. For the most part this feedback was positive, with some places to grow and implement changes. The EuroHPC JU's first European Parliamentary discharge in respect of the implementation of the JU's budget for 2020 was granted and adopted by the European Parliament in May 2022.

In 2021, and despite the challenges presented by the Covid-19 pandemic, the EuroHPC Joint Undertaking continued to meet the milestones defined by the Governing Board to fulfil its strategic mission. Results of our supercomputer helped to find new medicals. The Board is of the opinion that the Annual Activity Report sets out the relevant highlights of the execution of the 2021 activities defined for the Joint Undertaking from both an operational and administrative point of view. The report will be sent to the European Parliament, Council of Ministers, Commission and Court of Auditors. It will form the basis of the discussion with the European Parliament in the preparation of the Budgetary Discharge in 2023.

The Board is pleased to note the acquisition and successful implementation of supercomputers (peta-scale and pre-exascale machines) that enable the set-up of a world-class HPC ecosystem in Europe that can address relevant and important socio-economic challenges. The installations of 4 petascale supercomputers were completed and the systems were put into operation in 2021. These supercomputers are Vega, Karolina, MeluXina and Discoverer. One partition of the LUMI supercomputer, LUMI-C, was also completed and put into operation. The LUMI supercomputer installation will be fully operational with the addition of LUMI-G partition (the GPU-based part of the supercomputer) which is currently under installation and expected to go online in summer 2022. Installation of Leonardo and Deucalion is also ongoing, and the

systems are expected to be completed in Q4 2022. The MareNostrum5 procurement was cancelled in May 2021. A new procurement was launched in December 2021.

The R&D&I activities realised by the JU have already a concrete and globally visible impact in strengthening the capacities of the European HPC community.

> Total number of beneficiaries in all 28 EuroHPC projects funded during the reporting period: 304

of which:

> % of SMEs: 21
>
> % of private for profit/large companies: 16

The Board appreciates the efforts applied to exploring synergies with other HPC initiatives, e.g. with PRACE and the KDTJoint Undertaking.

The Board is pleased about the excellent dissemination of the JU's activities. The Inauguration of the supercomputers (VEGA, Meluxina and Discoverer) were all good opportunities to communicate about the positive work of the Joint Undertaking.

The Board notes that no critical risks have been identified regarding the JU's main business processes and internal controls and is pleased to note the further development and strengthening of the risk management approach, in particular enhancing the systematic monitoring of technical and financial risks in the projects.

The main risks associated with the initial actions regarding the setting-up and the financial autonomy of the EuroHPC JU have been appropriately addressed and overcome.

The Board takes note that the JU has fulfilled its monitoring tasks through the implementation and usage of dedicated key performance indicators (KPIs) for the achievement of strategic objectives.

5.2. ELEMENTS SUPPORTING ASSURANCE

All support expenditures were performed in accordance with the European Commission rules and procedures following DG Communications Networks, Content and Technology's business processes.

5.3. RESERVATIONS

After the first full year of operations since the JU gained autonomy, the main challenges included:

- Recruiting new staff;
- Implementing and managing the procurement contracts of the eight supercomputers and the delay of MareNostrum5
- Facing and responding to the legal challenge of the Lenovo vs EuroHPC JU action
- Getting acquainted with financial and administrative tasks and procedures which had previously been managed by the Commission;
- Onboarding new staff and building a new team in the COVID-19 context;
- Additional task due to new council regulation, managing five programmes (H2020, CEF1, CEF2, Horizon Europe and DEP) with same staff

Priorities had to be drawn in order to ensure business continuity in line with the objectives of the EuroHPC JU. When any mistakes were identified, they were rectified immediately and clearly documented. As the team grew with new staff members, the HR, Finance, and Legal departments were reinforced in 2021.

5.4. OVERALL CONCLUSION

In 2021, the EuroHPC Joint Undertaking was in a transition year between the old Regulation and the new Regulation. It also saw the end of Horizon 2020 and the late introduction of new funding programmes for the JU : Horizon Europe, DEP and CEF. In early 2021, the EuroHPC JU parent DG Communications Networks, Content and Technology continued to support the work of the JU and the standard Commission monitoring and risks-mitigating procedures.

In conclusion, the management of this Joint Undertaking has reasonable assurance that, overall, suitable controls are in place and working as intended, risks are being appropriately monitored and mitigated, and necessary improvements and reinforcements are being implemented. Therefore, the Executive Director, in his capacity as Authorising Officer, has signed the declaration of assurance presented below.

6. DECLARATION OF ASSURANCE

I, the undersigned, Anders Dam Jensen

Executive Director of the European High Performance Joint Undertaking (EuroHPC JU)

In my capacity as Authorising Officer

Declare that the information contained in this report gives a true and fair view[11]*.*

State that I have reasonable assurance that the resources assigned to the activities described in this report have been used for their intended purpose and in accordance with the principles of sound financial management, and that the control procedures put in place give the necessary guarantees concerning the legality and regularity of the underlying transactions.

This reasonable assurance is based on my own judgement and on the information at my disposal, such as the results of the self-assessment, ex-post controls, the work of the internal audit capability, the observations of the Internal Audit Service and the lessons learnt from the reports of the Court of Auditors for years prior to the year of this declaration.

Confirm that I am not aware of anything not reported here which could harm the interests of the Joint Undertaking.

Luxembourg, 22 June 2022

Anders Dam Jensen

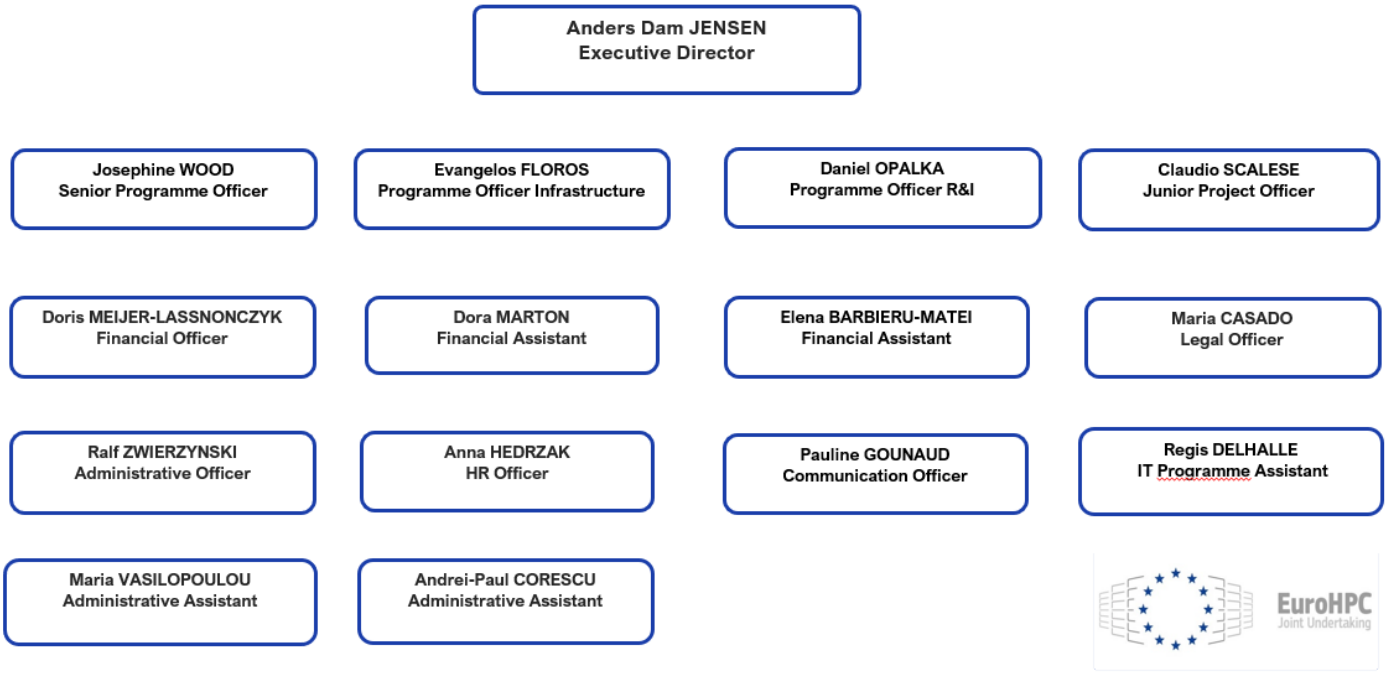
[11] True and fair in this context means a reliable, complete and correct view on the state of affairs in the Joint Undertaking.

ANNEXES

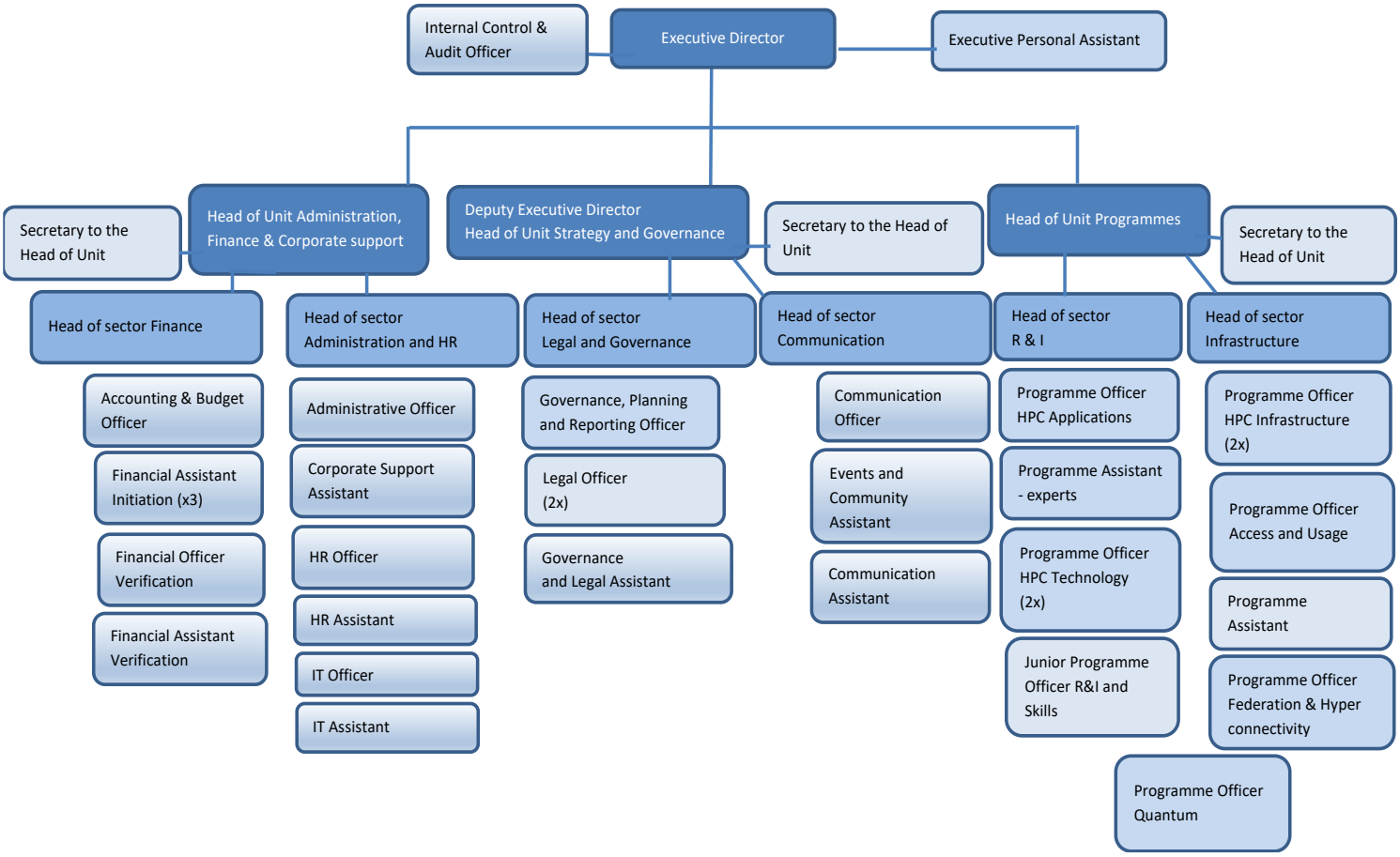
1. ORGANISATIONAL CHART
2. ESTABLISHMENT PLAN
3. HORIZON 2020 COMMON KPIS
4. INDICATORS FOR MONITORING CROSS-CUTTING ISSUES
5. LIST OF GOVERNING BOARD MEMBERS
6. LIST OF ACRONYMS
7. MATERIALITY CRITERIA

ANNEX 1: ORGANISATIONAL CHART (APPROVED BY THE GOVERNING BOARD - DECEMBER 2021)

At the beginning of 2021, the JU organisational chart was composed of 15 positions.



With the adoption of the Regulation 2021/1173, EuroHPC JU's Governing Board approved the following organisational chart and staff establishment plan in December 2021 and recruitment will take place in 2022.


Internal Control & Audit Officer
Executive Director
Executive Personal Assistant
Secretary to the Head of Unit
Head of Unit Administration, Finance & Corporate support
Deputy Executive Director Head of Unit Strategy and Governance
Secretary to the Head of Unit
Head of Unit Programmes
Secretary to the Head of Unit
Head of sector Finance
Head of sector Administration and HR
Head of sector Legal and Governance
Head of sector Communication
Head of sector R & I
Head of sector Infrastructure
Accounting & Budget Officer
Financial Assistant Initiation (x3)
Financial Officer Verification
Financial Assistant Verification
Administrative Officer
Corporate Support Assistant
HR Officer
HR Assistant
IT Officer
IT Assistant
Governance, Planning and Reporting Officer
Legal Officer (2x)
Governance and Legal Assistant
Communication Officer
Events and Community Assistant
Communication Assistant
Programme Officer HPC Applications
Programme Assistant - experts
Programme Officer HPC Technology (2x)
Junior Programme Officer R&I and Skills
Programme Officer Quantum
Programme Officer HPC Infrastructure (2x)
Programme Officer Access and Usage
Programme Assistant
Programme Officer Federation & Hyper connectivity

ANNEX 2: STAFF ESTABLISHMENT PLAN (APPROVED IN DECEMBER 2021)

With the adoption of the Regulation 2021/1173, EuroHPC JU will recruit a number of new roles to support its work. Here is the detail of the different roles that have been described in the organisation chart above.

Executive Director (TA-AD14)

The Executive Director is the chief executive responsible for the day-to-day management of the EuroHPC Joint Undertaking, providing leadership at the strategic and operational level ensuring the achievement of the Joint Undertaking's objectives. The Executive Director is its legal representative and performs his tasks with independence. He is accountable to the Governing Board.

Executive Personal Assistant (TA-AST4) – VACANT

The Executive Secretary provides the secretarial support to the Executive Director, and the Deputy Executive Director. She/he organises the activities of the Executive Director's Office. She/he provides administrative support in relations with the ED and Deputy ED's external meetings. She/he does the general coordination with the JU Units of tasks which concern the whole JU such as meeting organisation, support to the Governing Board, document management etc. She/he registers and dispatches the incoming correspondence for the ED office.

Internal Control and Audit Officer (CA - FGIV) - VACANT

The Internal Control and Audit Officer provides advice on risk management and internal control and ensures that risks are appropriately and continuously identified and managed.

She/he maintains and keeps up to date the Internal Control System of the JU. She/he evaluates the effectiveness of the internal control strategy and related system and provides advice to the management on improving the sound financial management and compliance.

She/he acts as a coordinator of risk assessment process, provides advice and guidance on the implementation of corrective/preventive actions and contributes to defining, maintaining and improving of the JU's procedures, processes and systems, in collaboration with different units.

She/he acts as contact point and coordinator with regard to the implementation of the internal audit function. She/he coordinates of audit implementation with all the relevant actors, monitors the audit reporting and the implementation of audit plan in view of audit related KPIs and follows-up on the implementation of the audit/findings/Action plan.

She/he draws up the annual audit plan of the internal audit capability taking into consideration inter alia the Executive Director's assessment of risk in the JU.

Deputy Executive Director and Head of Unit Strategy and Governance (TA-AD12) - VACANT

The Deputy Executive Director supports the Executive Director in his work and decisions. She/he acts on behalf of the Executive Director during his absence. She/he supports the Executive Director in day-to-day management and overall coordination of the JU.

In his/her capacity as the Head of Unit, she/he oversees the governance, legal, strategic coordination, stakeholders relations and communication activities of the JU. She/he ensures supports the ED in the coordination of the Governing Board and other Advisory Committees, ensuring the optimal outreach of the JU messages, as well as the dissemination of results, in line with JU's objectives. She/he oversees the governance aspects of the JU and relations with stakeholders. The HoU oversees the planning and reporting of the JU, as well as the activities of the legal team which include procurement activities and support to the Operational teams in the JU. She/he coordinates the preparation of the Annual Strategic Plans and the Multi-Annual Strategic Plans.

Secretary to the Head of Unit (CA-FGII)

The Secretary to the Head of Unit provides the secretarial support to the Unit. He assists the Head of Unit with ensuring the follow-up and respect of deadlines in the Unit activities. He coordinates the document management of the Unit, assists in preparation of missions, prepares / copies documents for transmission and maintains files, provides administrative and logistical support for the organisation of internal and external events such as meetings, workshops, conferences and public events; participates in the planning of logistical needs of the unit.

Head of Sector Legal and Governance (TA-AD8) - VACANT

The Head of Sector Legal and Governance coordinates the day-to-day work of the team. She/he coordinates the legal advice in all aspects related to the functioning of the JU, such as procurement, HR, governance etc. She/he oversees the documentation related to the grants and procurement procedures, as well as governance of the JU. She/he contributes to JU reporting documents.

Governance, Planning and Reporting Officer (TA-AD6) - VACANT

The Governance, Planning and Reporting Officer manages the secretariat of the Governing Board of the JU. She/he plans and organizes meetings of the Governing Board, including all required documentation and voting procedures. She/he works with the legal team on all Decisions of the GB and other legal or procedural documents.

She/he coordinates drawing up of the key planning and reporting documents of the JU, such as the Annual Activity Reports. She/he provides input into the Annual Work Programmes.

She/he provides input into the definition of JU's objectives and performance monitoring tools. She/he monitors progress in planning and programming and reports on it. She/he ensures systematic monitoring and follow-up of strategic decisions and actions.

Legal Officer (CA-FGIV)

The Legal Officer provides the Executive Director and the JU Team with all relevant legal advice and support for the smooth operation of the activities of the JU, monitors the implementation of contractual obligations of the JU, drafts legal documents of the JU and is the JU's Data Protection Officer. She assists in the implementation of the staff policy and ensures compliance with EU and JU rules and regulations. She supports the Planning and Reporting Officer in preparing decisions for the Governing Board. She supports the Operational teams on legal aspects of procurement and grants. She provides liaises with external lawyers (where required) and provides input to the legal procedures and litigations.

Legal Officer (CA-FGIV) – VACANT

The Legal Officer provides advice on the legality and compliance of the grant agreements and procurement procedures. She/he supports Programme Officers and other units in drafting tender documents (invitations to tender, technical specifications, contracts). She/he provides support for contract activities including drafting and reviews of contract and amendment templates.

She/he contributes to preparation of manuals, vade-mecums and internal procedures. She/he provides legal advice related to the implementation of procurement contracts and grant agreements.

Governance and Legal Assistant (CA-FGIII) - VACANT

Governance and Legal Assistant provides support with updating templates, checklists, and any other documents related to the procurement and Model Grant Agreement cycles. She/he supports the communication with the members of the JU's Governing Board, assist in preparation of the supporting documents, and oversees the correspondence, including invitations, voting etc.

She/he creates templates and repository of legal advice and supports the team with drafting replies to new requests. She/he supports Programme Officers in performing administrative verification of received offers.

Head of Sector Communication (TA-AD8) – VACANT

The Head of Sector coordinates the work of the sector. She/he supports the Head of Unit in defining effective communication policy and strategy, in order to increase the visibility and positioning of JU as an important actor in the HPC ecosystem. She/he will oversee the design and implementation of communication campaigns, press relations and events.

She/he oversees the production of online and offline materials to convey and disseminate key messages of the JU. She/he will support the Head of Unit in providing relevant KPIs and other data demonstrating that the objectives of the JU are reached. She/he ensures adequate outreach and dissemination of information related to the JU's initiatives and results.

Communication Officer (CA – FGIV)

The Communication Officer is responsible for the JU's communication, press activities, including managing the JU website, developing and overseeing the execution of a communications activity plan implementing the Communications Strategy of the JU. She is responsible for media relations. In collaboration with the Programme Officers and Director's Office, she/he reports on the HPC projects and procurement stories and best practice.

Events and Community Assistant (CA – FGIII) - VACANT

The Events and Community Assistant supports the organization of internal and external meetings and events and community-building activities of the JU. In collaboration with the Programme Officers and Director's Office, she/he identifies the speaking opportunities for the JU representatives at external events and coordinates JUs presence at such events.

She/he works closely with other units, in particular the Programmes Unit, in order to deliver on the stakeholder needs and position the JU as an important actor of the HPC community.

She/he assists other team members in providing the tools and platforms supporting effective communication and community building, such as newsletters, online discussion fora, expert groups, networking events etc.

Communication Assistant (CA – FGIII) - VACANT

The Communication Assistant supports the team in the implementation of the communication strategy, and in particular drafting texts, information gathering, press monitoring and dissemination of clippings, managing social media, providing input to newsletters etc., maintaining databases of press contacts, preparation of contracts for external support to organise events such as EuroHPC Summit. She/he supports the team in the organization of internal and external events.

Head of Unit Programmes (TA-AD10) - VACANT

The Head of Programmes is central to the implementation of the JU's Programmes, overseeing the work the procurement and R&I activities. She/he seeks to enhance the quality, efficiency and effectiveness of the programmes managed by the JU, overseeing the work performed within the projects implementing the JU Programme to achieve its objectives. She/he gives scientific and technical direction to the unit and coordinate the scientific input of the JU's Advisory Boards into the planning activities of the JU. She/he provides direction to the Programmes Unit and its staff including the HR management aspects.

Secretary to the Head of Unit (CA-FGII) - VACANT

The Secretary to the Head of Unit provides the secretarial support to the Unit. She/he assists the Head of Unit with ensuring the follow-up and respect of deadlines in the Unit activities. She/he coordinates the document management of the Unit, assists in preparation of missions, prepares / copies documents for transmission and maintains files, provides administrative and logistical support for the organisation of internal and external events such as meetings, workshops, conferences and public events; participates in the planning of logistical needs of the unit.

Head of Sector R & I (TA – AD8)

The Head of Sector coordinates the activities related to the R & I. He provides input to the yearly Work Programme. He coordinates the work of the team in the R&I sector.

He organises and is involved in the evaluation of proposals (selection of experts, logistics etc.), manages the process of selection of projects, monitors and reviews the execution of grant agreements, carries out project reviews and ensures compliance with the prevailing rules and regulations. He works with the other Programme Officers and also negotiates strategic, scientific, managerial and financial aspects of research contracts and amendments.

He liaises with relevant JU stakeholders and communities of experts.

Head of Sector Infrastructure (TA-AD8)

The Head of Sector coordinates the activities related to the Infrastructure. He provides input to the yearly Work Plan. He coordinates the work of the team in the Infrastructure sector.

He organises and is involved in the evaluation of public tenders (publication, opening, selection of experts, logistics etc.), manages the selection process, monitors and reviews the execution of associated contracts, monitors the allocation of supercomputer access times and ensures compliance with the prevailing rules and regulations. He liaises with relevant JU stakeholders and communities of experts.

Programme Officer HPC Infrastructure (TA-AD7) – VACANT

The Programme Officer organises and is involved in the evaluation of public tenders (publication, opening, selection of experts, logistics etc.), contributes to the development of tender and technical specifications, manages the selection process, monitors and reviews the execution of associated contracts, monitors the allocation of supercomputer access times and ensures compliance with the prevailing rules and regulations.

She/he liaises with relevant JU stakeholders and communities of experts.

Programme Officer HPC Infrastructure (TA-AD7) – VACANT

The Programme Officer organises and is involved in the evaluation of public tenders (publication, opening, selection of experts, logistics etc.), contributes to the development of tender and technical specifications, manages the selection process, monitors and reviews the execution of associated contracts, monitors the allocation of supercomputer access times and ensures compliance with the prevailing rules and regulations.

She/he liaises with relevant JU stakeholders and communities of experts.

Programme Officer Federation & Hyper connectivity (TA-AD7) - VACANT

The Programme Officer organises and is involved in the evaluation of public tenders (publication, opening, selection of experts, logistics etc.), manages the selection process, monitors and reviews the execution of associated contracts, monitors the allocation of supercomputer access times and ensures compliance with the prevailing rules and regulations.

The PO F&H contributes to the Federation and Hyperconnectivity pillar of the JU overviewing the implementation of actions and policies necessary to establish the relevant services within the pan-European HPC infrastructure deployed and operated by the JU.

Programme Officer Access and Usage (TA-AD7) – VACANT

The Programme Officer organises and is involved in the definition and implementation of the EuroHPC JU Access Policy. He aids in the definition of the various calls for Access published by the JU and the implementation of the various Peer-review processes and evaluations organized as part of the Access Policy implementation. She/he monitors the allocation of supercomputer access times, ensures compliance of the Hosting Entities activities in terms of access provision and user support as defined in the respective Hosting Agreements.

Programme Assistant (CA-FGIII) – VACANT

The Programme Assistant provides support to the implementation of the JUs programme management activities, such as evaluation of proposals for R&D grants and public tenders, grant preparation, monitoring the technical execution of the grants and provides any technical support to the Programme Officers. She/he also supports the auditing activities including KPIs related to grants and procurement activities and ensures compliance with applicable rules and regulations.

She/he provides administrative support to the Programme Officers.

Programme Officer Quantum Computing (TA-AD7) - VACANT

The Programme Officer organises and is involved in the evaluation of public tenders (publication, opening, selection of experts, logistics etc.), and grants, manages the selection process, monitors and reviews the execution of associated contracts, monitors and reviews the execution of grant agreements, carries out project reviews and ensures compliance with the prevailing rules and regulations.

The PO Quantum contributes to the delivery of strategic goals and the implementation of mandate of the JU in what concerns the development of Quantum technologies and the procurement and deployment of Quantum computers in Europe.

Programme Officer HPC Applications (TA-AD7) - VACANT

The Programme Officer organises and is involved in the evaluation of proposals (selection of experts, logistics etc.), manages the process of selection of projects, with the prevailing rules and regulations. She/he works with the other Programme Officers and also negotiates strategic, scientific, managerial and financial aspects of research contracts and amendments.

Programme Officer HPC Technology (TA-AD7) - VACANT

The Programme Officer organises and is involved in the evaluation of proposals (selection of experts, logistics etc.), manages the process of selection of projects, monitors and reviews the execution of grant agreements, carries out project reviews and ensures compliance with the prevailing rules and regulations. She/he works with the other Programme Officers and also negotiates strategic, scientific, managerial and financial aspects of research contracts and amendments.

Programme Officer HPC Technology (TA-AD7) - VACANT

The Programme Officer organises and is involved in the evaluation of proposals (selection of experts, logistics etc.), manages the process of selection of projects, monitors and reviews the execution of grant agreements, carries out project reviews and ensures compliance with the prevailing rules and regulations. She/he works with the other Programme Officers and also negotiates strategic, scientific, managerial and financial aspects of research contracts and amendments.

Junior Project Officer (FGIII)

The Junior Project Officer organises and is involved in the evaluation of proposals (selection of experts, logistics etc.), manages the process of selection of projects, monitors and reviews the execution of grant agreements, carries out project reviews and ensures compliance with the prevailing rules and regulations. She/he works with the other Programme Officers and also negotiates strategic, scientific, managerial and financial aspects of research contracts and amendments.

Programme Assistant – experts (CA-FGIII) – VACANT

The Programme Assistant – experts supports the team in all aspects related to experts' management: selection, communication and planning, contract preparation, reimbursement of costs, payments etc.

She/he supports the Programme Officers in the logistical aspects of the organization of evaluation panels.

Head of Unit Administration, Finance and HR (TA-AD10) – VACANT

The Head of Administration is responsible for managing the human and financial resources of the JU according to the principle of sound financial management and in compliance with underlining regulations. She/he will also be responsible for implementing internal controls aiming at providing reasonable assurance regarding the achievement of objectives relating to operations, reporting, and compliance.

She/he contributes to the development of the budgetary and financial resource management procedures of the JU. She/he ensures the follow-up of recommendations issued by the IAS and the Court of Auditors. She/he ensures the effective management of the IT infrastructure and specific applications needed to support the activities of the JU

Secretary to the Head of Unit (CA-FGII)

The Secretary to the Head of Unit provides the secretarial support to the Unit. She assists the Head of Unit with ensuring the follow-up and respect of deadlines in the Unit activities. She coordinates the document management of the Unit, assists in preparation of missions, prepares / copies documents for transmission and maintains files, provides administrative and logistical support for the organisation of internal and external events such as meetings, workshops, conferences and public events; participates in the planning of logistical needs of the unit.

Head of Sector Administration and HR (TA-AD8) – VACANT

The Head of Sector Administration and HR coordinates the logistical, administrative, human resources and IT/infrastructure aspects of the JU operations. She/he coordinates the work of the team. She/he ensures that measures are in place to provide a safe working environment, tailored to the JU's business needs and compliant with applicable rules and requirements.

She/he oversees the recruitment, training and wellbeing of JU staff, stimulating the collaborative working methods and team spirit.

She/he ensures that the adequate tools and procedures are in place, in order to guarantee the efficiency of administrative processes and effective functioning of the JU.

Administrative Officer (CA-FGIV)

The Administrative Officer maintains the Unit activity plans and ensures follow-up and respect of deadlines of the JU activities, provides support to the activities of the Governing Board, contributes to administrative quality checks on files for signature, participates in the planning of JU's infrastructure and logistics needs.

He implements relevant Service Level Agreements and framework and other procurement contracts, ensuring effective and efficient operations of the JU.

Corporate Support Assistant (CA-FGIII) – VACANT

Corporate Support Assistant supports the Administration and HR Unit in preparation and implementation of relevant contracts and agreements, such as SLAs and Framework and other procurement contracts with external service providers/suppliers.

She/he is involved in office supplies planning, in coordination with other units. She/he supports Unit in organization of internal events.

She/he will liaise with building administration and other internal and external services in order to ensure compliance with applicable Health & Safety rules. She/he provides support to the organization of the office move and preparation of the office space for newcomers.

HR Officer (CA – FGIV)

The HR Officer is responsible for the design and implementation of the Human Resources Management strategy and the HR policies and procedures of the JU, in line with applicable rules and regulations and JU's mission and objectives.

She implements the necessary IT tools, related to Human Resources Management. She organizes initiatives aiming at ensuring staff well-being.

HR Assistant (CA – FGIII) - VACANT

The HR Assistant supports the HR Officer in recruitment and selection procedures and day-to-day Human Resources Management, including HR personnel files, learning and development, SYSPER (leave manager).

She/he manages relevant HR functional mailboxes and ARES files.

IT Officer (CA – FGIV) - VACANT

The IT Officer provides appropriate definition of requirements, implementation of policy and maintenance of the ICT infrastructure and service of the JU. She/he contributes to the preparation of the budget and provides IT-related input into JU's activity reports.

The IT Officer oversees the management of the IT infrastructure of the JU, ensuring compliance with applicable rules and requirements. She/he monitors to correct operation of the systems, ensuring that the IT systems respond to business needs.

She/he plans the hardware and software needs of the JU and ensures their timely procurement.

IT Assistant (CA – FGIII)

IT Assistant is responsible for the day-to-day management of IT and Telecommunication Systems of the JU. He provides help-desk assistance to JU staff. He supports the IT Officer in preparation of contracts and purchase orders, in order to ensure that the JU's IT needs are met.

He provides input into the budgetary planning and reporting.

Head of Sector Finance (TA-AD8) – VACANT

She/he leads a team of financial officers and assistants, contributing to the sound implementation of the JU's administrative and operational budget, compliant with EC Financial Regulation and ensures overall coordination with the other actors of the financial circuits. She/he oversees the financial procedures and circuits and model documents.

She/he provides input to budgetary planning and contributes to the design, implementation and evaluation of the JU's control mechanisms and fraud prevention.

Accounting & Budget Officer (CA-FGIV)

The Accounting & Budget Officer monitors that the JU is complying with the applicable EU financial and accounting rules, is the interface with the EC Accountant (DG BUDG), provides advice and recommendations to improve the efficiency, effectiveness and financial management of the JU.

She prepares annual budgetary and financial accounts and monitors budget execution. She contributes to the preparation of the Annual Activity report, including the corresponding costs. She prepares and manages reporting on budgetary and general accounts. She contributes to the development and implementation of financial procedures and the elaboration and updating of model documents.

Financial Assistant Initiation (CA-FGIII) – 3 posts – 1 VACANT

The Financial Assistant is responsible for the financial initiation with regard to administrative and operational expenditure (budget, procurement and grants) of the JU. She/he ensures the financial and administrative compliance of the grants and contracts, performs the administrative quality checks on files for signature, monitors the operational and administrative expenditures.

She/he provides support in the preparation, planning, reporting, forecast and follow-up of the budget.

Financial Officer Verification (CA-FGIV) - VACANT

The Financial Officer verifies the financial and administrative compliance of the grants, contracts and procedures, performs the administrative quality checks on files for signature, monitors the operational and administrative expenditures. She/he performs ex-ante verification of commitments, payments and recovery orders. She/he ensures legality and regularity by verifying the respect of Financial Regulation and other related rules and budgetary dispositions.

ANNEX 3: HORIZON 2020 INDICATORS FOR JOINT UNDERTAKINGS

- Table I shows the Horizon 2020 KPIs which apply to JUs, both under Industrial Leadership and Societal Challenges (Horizon 2020 Key Performance Indicators (Annex II - Council Decision 2013/743/EU)).

- Table II presents all indicators for monitoring of cross-cutting issues which apply to JUs (Annex III - Council Decision 2013/743/EU).

- In tables I and II, the numbers attributed to the indicators correspond with those in the Horizon 2020 indicators approved by the RTD Director-General and agreed by all the Research family DGs (according to Annexes II and III - Council Decision 2013/743/EU). The missing numbers correspond to KPIs not applicable to the JUs.

- KPIs and Indicators that correspond to those approved by the RTD Director-General are presented with a white background in the tables. They are aligned to what has been discussed between the Common Support Centre and the JUs. KPIs and monitoring indicators in tables I and II, which do not correspond to those approved by the RTD Director-General, are presented with a green background in the tables.

- Table III presents the KPI specific for each JU, as transmitted by the Programme Offices or the operational services.

- Lastly, now that the new Regulation is adopted, it is expected that the Governing Board will start discussions in 2022 to agree and approve EuroHPC JU specific KPIs.

TABLE I : HORIZON 2020 KEY PERFORMANCE INDICATORS[12] COMMON TO ALL JUS

		Key Performance Indicator	Definition/Responding to Question	Type of Data Required	Data to be Provided by	Baseline at the Start of Horizon 2020 (latest available)	Target at the End of Horizon 2020	EuroHPC JU
EVALUATION	NA	Time to inform (TTI) all applicants of the outcome of the evaluation of their application from the final date for submission of completed proposals	To provide applicants with high quality and timely evaluation results and feedback after each evaluation step by implementing and monitoring a high scientific level peer reviewed process	Number and % of information letters sent to applicants within target Average TTI (calendar days) Maximum TTI (calendar days)	Joint Undertaking	FP7 latest know results?	153 calendar days	**23% within target** **167 days** **Max. TTI: 182 days**
	NA	Redress after evaluations	To provide applicants with high quality and timely evaluation results and feedback after each evaluation step by implementing and monitoring a high scientific level peer reviewed process	Number of redresses requested	Joint Undertaking	FP7 latest know results?		**1**

[12] (based on Annex II to Council Decision 2013/743/EU)

		Key Performance Indicator	Definition/Responding to Question	Type of Data Required	Data to be Provided by	Baseline at the Start of Horizon 2020 (latest available)	Target at the End of Horizon 2020	EuroHPC JU
GRANTS	NA	Time to grant (TTG) measured (average) from call deadline to signature of grants	To minimise the duration of the granting process aiming at ensuring a prompt implementation of the Grant Agreements through a simple and transparent grant preparation process	Number and % of grants signed within target Average TTG in calendar days Maximum TTG in calendar days	Joint Undertaking	n.a. [new approach under Horizon 2020]	TTG < 243 days (as %of GAs signed)	**0% within target** **348** **Max. TTG: 484 days**
	NA	Time to sign (TTS) grant agreements from the date of informing successful applicants (information letters)		Number and % of grants signed within target Average TTG in calendar days Maximum TTG in calendar days	Joint Undertaking	n.a. [new approach under Horizon 2020]	TTS 92 calendar days	**4% within target** **171** **Max. TTS: 326 days**
PAYMENTS	NA	Time to pay (TTP) (% made on time) -pre-financing - interim payment -final payment	To optimize the payments circuits, both operational and administrative, including payments to experts	Average number of days for Grants pre-financing, interim payments and final payments; Average number of days for administrative payments; Number of experts appointed	Joint Undertaking	FP7 latest know results?	-pre-financing (30 days) - interim payment (90 days) -final payment ((90days)	

		Key Performance Indicator	Definition/Responding to Question	Type of Data Required	Data to be Provided by	Baseline at the Start of Horizon 2020 (latest available)	Target at the End of Horizon 2020	EuroHPC JU
HR	NA	Vacancy rate (%)		% of post filled in, composition of the JU staff [13]	Joint Undertaking	n.a. [new approach under Horizon 2020]		**0%**
JU EFFICIENCY	NA	Budget implementation/execution: 1. % CA to total budget 2. % PA to total budget	Realistic yearly budget proposal, possibility to monitor and report on its execution, both in commitment (CA) and payments (PA), in line with sound financial management principle	% of CA and PA	Joint Undertaking		100% in CA and PA	**Nothing to report at this stage**
	NA	Administrative Budget: Number and % of total of late payments	Realistic yearly budget proposal, possibility to monitor and report on its execution in line with sound financial management principle	Number of delayed payments % of delayed payments (of the total)	Joint Undertaking			**The JU did not have any late payments in 2021**

NOTES:

18* This indicator is not a legally compulsory one, but it covers several additional specific indicators requested for more societal challenges by the services in charge.

[13] Additional indicators can be proposed/discussed with R.1 and/or DG HR

ANNEX 4: INDICATORS FOR MONITORING HORIZON 2020 CROSS-CUTTING ISSUES[14] COMMON TO ALL JUS

TABLE II

	Cross-cutting issue	Definition/Responding to Question	Type of Data Required	Data to be Provided by	Data to be Provided in/to	Direct Contribution to ERA	Automated
2	Widening the participation	2.1 Total number of participations by EU-28 Member State	Nationality of Horizon 2020 applicants & beneficiaries (number of)	Horizon 2020 applicants & beneficiaries at the submission and grant agreement signature stage	JU AAR RTD Monitoring Report	YES	Yes
		2.2 Total amount of EU financial contribution by EU-28 Member State (EUR millions)	Nationality of Horizon 2020 beneficiaries and corresponding EU financial contribution	Horizon 2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report	YES	Yes
NA		Total number of participations by Associated Countries	Nationality of Horizon 2020 applicants & beneficiaries (number of)	Horizon 2020 applicants & beneficiaries at the submission and grant agreement signature stage	JU AAR RTD Monitoring Report	YES	Yes
NA		Total amount of EU financial contribution by Associated Country (EUR millions)	Nationality of Horizon 2020 beneficiaries and corresponding EU financial contribution	Horizon 2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report	YES	Yes

[14] (based on Annex III to Council Decision 2013/743/EU)

	Cross-cutting issue	Definition/Responding to Question	Type of Data Required	Data to be Provided by	Data to be Provided in/to	Direct Contribution to ERA	Automated
3	SMEs participation	3.1 Share of EU financial contribution going to SMEs (Enabling & industrial tech and Part III of Horizon 2020)	Number of Horizon 2020 beneficiaries flagged as SME; % of EU contribution going to beneficiaries flagged as SME	Horizon 2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report		Yes
6	Gender	6.1 Percentage of women participants in Horizon 2020 projects	Gender of participants in Horizon 2020 projects	Horizon 2020 Beneficiaries through project reporting	JU AAR	YES	Yes
		6.2 Percentage of women project coordinators in Horizon 2020	Gender of MSC fellows, ERC principle investigators and scientific coordinators in other Horizon 2020 activities	Horizon 2020 beneficiaries at the grant agreement signature stage	JU AAR	YES	Yes
		6.3 Percentage of women in EC advisory groups, expert groups, evaluation panels, individual experts, etc.	Gender of memberships in advisory groups, panels, etc.	Compiled by Responsible Directorate/ Service/Joint Undertaking based on existing administrative data made available by the CSC	JU AAR	YES	
7	International cooperation	7.1 Share of third-country participants in Horizon 2020	Nationality of Horizon 2020 beneficiaries	Horizon 2020 beneficiaries at the grant agreement signature stage	JU AAR RTD Monitoring Report	YES	Yes
		7.2 Percentage of EU financial contribution attributed to third country participants	Nationality of Horizon 2020 beneficiaries and corresponding EU financial contribution	Horizon 2020 beneficiaries at the grant agreement signature stage	JU AAR RTD Monitoring Report	YES	Yes

	Cross-cutting issue	Definition/Responding to Question	Type of Data Required	Data to be Provided by	Data to be Provided in/to	Direct Contribution to ERA	Automated
9	Bridging from discovery to market [15]	9.1 Share of projects and EU financial contribution allocated to Innovation Actions (IAs)	Number of IA proposals and projects properly flagged in the WP; follow up at grant level.	Project Office – at GA signature stage he/she will be required to flag on SYGMA. Responsible Directorate/Service (WP coordinator)/Joint Undertaking - via tool CCM2	JU AAR RTD Monitoring Report		Yes
		9.2 Within the innovation actions, share of EU financial contribution focussed on demonstration and first-of-a-kind activities	Topics properly flagged in the WP; follow-up at grant level	Responsible Directorate/Service (WP coordinator)/Joint Undertaking - via tool CCM2	JU AAR RTD Monitoring Report		Yes
NA		Scale of impact of projects (High Technology Readiness Level)	Number of projects addressing TRL[16] between …(4-6, 5-7)?	Joint Undertaking	JU AAR RTD Monitoring Report		
11	Private sector participation	11.1 Percentage of Horizon 2020 beneficiaries from the private for profit sector	Number of and % of the total Horizon 2020 beneficiaries classified by type of activity and legal status	Horizon 2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report		Yes
		11.2 Share of EU financial contribution going to private for profit entities (Enabling & industrial tech and Part III of Horizon 2020)	Horizon 2020 beneficiaries classified by type of activity; corresponding EU contribution	Horizon 2020 beneficiaries at grant agreement signature stage	JU AAR RTD Monitoring Report		Yes

[15] This indicator (9.2) is initially intended to monitor the Digital Agenda (its applicability could be only partial)

[16] TRL: Technology Readiness Level

	Cross-cutting issue	Definition/Responding to Question	Type of Data Required	Data to be Provided by	Data to be Provided in/to	Direct Contribution to ERA	Automated
12	Funding for PPPs	12.1 EU financial contribution for PPP (Art 187)	EU contribution to PPP (Art 187)	Responsible Directorate/Service/	JU AAR		Yes
		12.2 PPPs leverage: total amount of funds leveraged through Art. 187 initiatives, including additional activities, divided by the EU contribution	Total funding made by private actors involved in PPPs - in-kind contribution already committed by private members in project selected for funding - additional activities (i.e. research expenditures/investment of industry in the sector, compared to previous year)	Joint Undertaking Services	JU AAR RTD Monitoring Report JU annual accounts (part of)		
13	Communication and dissemination	13.3 Dissemination and outreach activities other than peer-reviewed publications - [Conferences, workshops, press releases, publications, flyers, exhibitions, trainings, social media, web-sites, communication campaigns (e.g. radio, TV)]	A drop down list allows to choose the type of dissemination activity. Number of events, funding amount and number of persons reached thanks to the dissemination activities	Horizon 2020 Beneficiaries through project reporting	JU AAR RTD Monitoring Report	YES	Yes
14	Participation patterns of independent experts	14.2 Proposal evaluators by country	Nationality of proposal evaluators	Responsible Directorate/Service/Joint Undertaking in charge with the management of proposal evaluation	JU AAR		
		14.3 Proposal evaluators by organisations' type of activity	Type of activity of evaluators' organisations	Responsible Directorate/Service/Joint Undertaking in charge with the	JU AAR	YES	

	Cross-cutting issue	Definition/Responding to Question	Type of Data Required	Data to be Provided by	Data to be Provided in/to	Direct Contribution to ERA	Automated
				management of proposal evaluation			
NA	Participation of RTOs and Universities	Participation of RTO[17]s and Universities in PPPs (Art 187 initiatives)	Number of participations of RTOs to funded projects and % of the total Number of participations of Universities to funded projects and % of the total % of budget allocated to RTOs and to Universities	Horizon 2020 beneficiaries at the grant agreement signature stage	JU AAR RTD Monitoring Report	YES	Yes
NA	Ethics	The objective is ensuring that research projects funded are compliant with provisions on ethics efficiently	% of proposals not granted because non-compliance with ethical rules/proposals invited to grant (target 0%); time to ethics clearance (target 45 days)[18]	Responsible Directorate/Service/Joint Undertaking	JU AAR RTD Monitoring Report		
NA	Audit	Error rate	% of common representative error; % residual error	CAS	JU AAR RTD Monitoring Report		Yes
NA		Implementation of ex-post audit results	Number of cases implemented; in total €million; ´of cases implemented/total cases	CAS	JU AAR RTD Monitoring Report		Yes

[17] RTO: Research and Technology Organisation

[18] Data relates to pre-granting ethics review. This time span runs in parallel to granting process.

Notes:

* Horizon 2020 applicants - all those who submitted Horizon 2020 proposals
* Horizon 2020 beneficiaries - all those who have signed a Horizon 2020 Grant Agreement
*Responsible Directorate - DG RTD Directorates and R&I DGs family in charge with management of Horizon 2020 activities
*Services -Executive Agencies and other external bodies in charge with Horizon 2020 activities
*Project officer - is in charge of managing Horizon 2020 projects in Responsible Directorate/Service including Executive Agencies

ANNEX 5: LIST OF GOVERNING BOARD MEMBERS (REGULATION 2021/1173)

COUNTRY	REPRESENTATIVE	SUBSTITUTE
Austria	Stefan Hanslik	Ingo Hegny
Bulgaria	Ivan Dimov	Yumer Kodzhayumer
Croatia		
Cyprus	Evgenios Epaminondou	Christos Aspris
Czech Republic	Vít Vondrák	Lenka Sutakova
Denmark	René Michelsen	Line Bekker Poulsen
Estonia	Toivo Räim	Martin Eessalu
Finland	Erja Heikkinen	Petteri Kauppinen
France	Laurent Crouzet	Jean-Noël Buis
Germany	Herbert Zeisel	Stefan Mengel Roland Krüppel
Greece	Nectarios Koziris	Petros Sampatakos
Hungary	István Erényi	Tamàs Maray
Iceland	Morris Riedel	Henning Arnor Ulfarsson
Ireland	Peter Healy	Lola Hourihane
Italy	Paola Inverardi	Stefano Fabris
Latvia	Sarmite Mickevica	Lauris Cikovskis
Lithuania	Tadas Juknevicius	Juozas Šulskus
Luxembourg	Mario Grotz	Gabriel Crean
Malta	Sandra Hili Vassallo	Trevor Sammut
Norway	Ulrike Jaekel	Pal S. Malm
Poland	Mariusz Sterzel	Cezary Blaszczyk Rafal Duczmal
Portugal	Paulo Quaresma	Rui Carlos Olieveira
Romania	Monica Alexandru	Dragoş-Cătălin Barbu

Slovak Republic	Lukáš Demovič	Juraj Kubica
Slovenia	Karolina Schlegel	Peter Sterle
Spain	Jose Juan Sanchez Serrano	Joaquin Serrano Agejas
Sweden	Magnus Friberg	Mikael Borg
The Netherlands	Wendy Hoogeboom	Annick Zweers
Turkey	Memhmet Mirat Satoglu	Onur Temizsoylu

ANNEX 6: LIST OF ACRONYMS

AAR – Annual Activity Report

ABAC – Accrual Based Accounting

CSA – Coordination and Support Actions

DG CNECT – Directorate-General Communications Networks, Content and Technology

DG RTD – Directorate-General Research and Innovation

EFTA – European Free Trade Association

EU – European Union

EuroHPC JU – European High Performance Computing Joint Undertaking

JU – Joint Undertaking

FR – Financial regulation

GB – Governing Board

HPC – High Performance Computer

IA – Innovation actions

ICF – Internal Control Framework

ICP – Internal Control Principles

INFRAG – Infrastructure Advisory Group

JTI – Joint Technology Initiatives

KPIs – Key Performance Indicators

MN5 – MareNostrum 5

RIA – Research and innovation actions

RIAG – Research and Innovation Advisory Group

SRIA – Strategic Research and Innovation Agenda

SMEs – Small and Medium Enterprises

TRL – Technology Readiness Level

WP – Work Plan

WP2021 – 2021 Work Plan

ANNEX 7: MATERIALITY CRITERIA

DG Research and Innovation's expenditure is composed of (in order of importance), indirectly managed grants, directly managed grants, and financial instruments and other direct spending mostly of an administrative nature. The error rate affecting payments is estimated yearly and per management system, following a methodology that takes into account the risk associated to the type of expenditure (in terms of probability and final financial impact).

Considering that around 70 % of the yearly expenditure is related to directly or indirectly managed research grants, and the fact that the research framework programmes' implementing bodies are sharing a common ex-post audit approach, the following section focusses on this specific management system.

Research framework programmes – common aspects

The assessment of the effectiveness of the different programmes' control system is based mainly, but not exclusively, on ex-post audits' results. The effectiveness is expressed in terms of detected and residual error rate, calculated on a representative sample on a multi-annual basis.

Assessment of the effectiveness of controls

The starting point to determine the effectiveness of the controls in place is the cumulative level of error expressed as the percentage of errors in favour of the EC budget, detected by ex-post audits, measured with respect to the amounts accepted after ex-ante controls.

However, to take into account the impact of the ex-post controls, this error level is adjusted by subtracting:

- Errors detected and corrected as a result of the implementation of audit conclusions.
- Errors corrected as a result of the extension of audit results to non-audited contracts with the same beneficiary.

This results in a residual error rate, which is calculated as follows:

$$\text{Re}\,sER\% = \frac{(\text{Re}\,pER\% * (P - A)) - (\text{Re}\,pERsys\% * E)}{P}$$

where:

ResER% residual error rate, expressed as a percentage.

RepER% representative error rate, or error rate detected in the common representative sample, expressed as a percentage. The RepER% is composed of complementary portions reflecting the proportion of negative systematic and non-systematic errors detected. This rate is the

same for all implementing entities, without prejudice to possibly individual detected error rates.

RepERsys% portion of the RepER% representing negative systematic errors, (expressed as a percentage). The RepERsys% is the same for all entities and it is calculated from the same set of results as the RepER%

P total requested EC contribution (€) in the auditable population (i.e. all paid financial statements).

A total requested EC contribution (€) as approved by financial officers of all audited financial statements. This will be collected from audit results.

E total non-audited requested EC contribution (€) of all audited beneficiaries.

The Common Representative Sample (CRS) is the starting point for the calculation of the residual error rate. It is representative of the expenditure of each FP as a whole. Nevertheless, the Director-General (or Director for the Executive Agencies) must also take into account other information when considering if the overall residual error rate is a sufficient basis on which to draw a conclusion on assurance (or make a reservation) for specific segment(s) of the Seventh Framework Programme (FP7)/Horizon 2020. This information may include the results of other ex-post audits, ex-ante controls, risk assessments, audit reports from external or internal auditors, etc. All this information may be used in assessing the overall impact of a weakness and considering whether to make a reservation or not.

If the CRS results are not used as the basis for calculating the residual error rate this must be clearly disclosed in the AAR, along with details of why and how the final judgement was made.

Should a calculation of the residual error rate based on a representative sample not be possible for a FP for reasons not involving control deficiencies,[19] the consequences are to be assessed quantitatively by making a best estimate of the likely exposure for the reporting year based on all available information. The relative impact on the Declaration of Assurance would then be considered by analysing the available information on qualitative grounds and considering evidence from other sources and areas. This should be clearly explained in the AAR.

Multiannual approach

The Commission's central services' guidance relating to the quantitative materiality threshold refers to a percentage of the authorised payments of the reporting year of the ABB expenditure. However, the Guidance on AARs also allows a multi-annual approach, especially for budget areas (e.g. programmes) for which a multi-annual control system is more effective. In such

19 Such as, for instance, when the number of results from a statistically-representative sample collected at a given point in time is not sufficient to calculate a reliable error rate.

cases, the calculation of errors, corrections and materiality of the residual amount at risk should be done on a "cumulative basis" on the basis of the totals over the entire programme lifecycle.

Because of its multiannual nature, the effectiveness of the Research and Innovation family services' control strategy can only be fully measured and assessed at the final stages in the life of the framework programme, once the ex-post audit strategy has been fully implemented and systematic errors have been detected and corrected.

In addition, basing materiality solely on ABB Activity Based Budgeting expenditure for one year may not provide the most appropriate basis for judgements, as ABB expenditure often includes significant levels of pre-financing expenditure (e.g. during the initial years of a new generation of programmes), as well as reimbursements (interim and final payments) based on cost claims that 'clear' those pre-financings. Pre-financing expenditure is very low risk, being paid automatically after the signature of the contract.

Notwithstanding the multiannual span of their control strategy, the Directors-General (and the Directors of the Executive Agencies) implementing Research and Innovation Framework Programmes are required to sign a statement of assurance for each financial reporting year. In order to determine whether to qualify this statement of assurance with a reservation, the effectiveness of the control systems in place needs to be assessed not only for the year of reference but also with a multiannual perspective, to determine whether it is possible to reasonably conclude that the control objectives will be met in the future as foreseen.

In view of the crucial role of ex-post audits defined in the respective common audit strategies, this assessment needs to check in particular whether the scope and results of the ex-post audits carried out until the end of the reporting period are sufficient and adequate to meet the multiannual control strategy goals.

The criteria for making a decision on whether there is material error in the expenditure of the DG or service, and thus, on whether to make a reservation in the AAR, will therefore be principally, though not necessarily exclusively, based on the level of error identified in ex-post audits of cost claims on a multi-annual basis.

Adequacy of the audit scope

The quantity of the (cumulative) audit effort carried out until the end of each year is measured by the actual volume of audits completed. The data is to be shown per year and cumulated, in line with the current AAR presentation of error rates. The multiannual planning and results should be reported in sufficient detail to allow the reader to form an opinion on whether the strategy is on course as foreseen.

The Director-General (or Director for the Executive Agencies) should form a qualitative opinion to determine whether deviations from the multiannual plan are of such significance that they seriously endanger the achievement of the internal control objective. In such a case, they would be expected to qualify their annual statement of assurance with a reservation.

Since 2007, the R&I Family has adopted a common audit strategy intended to ensure the legality and regularity of expenditure on a multi-annual basis, including detection and correction of non-systematic and systematic errors.

For Horizon 2020, the Common Audit Service of the Common Implementation Centre carries out all audits, including those concerning grants concluded by the Executive Agencies and the Joint Undertakings. This is a major step towards ensuring a harmonised approach, legal certainty, equality of treatment and minimising the audit burden on beneficiaries.

The main indicators on legality and regularity[20] of EU Framework Programmes for Research and Innovation are:

- Representative detected error rate, based on errors detected by ex-post audits on a Common Representative Sample of cost claims across the R&I Family.
- Cumulative residual error rate, which is the extrapolated level of error after corrective measures have been implemented by the Commission services following the audits, accumulated on a multi-annual basis.

The targets set for this control system are respectively**:**

- for the Seventh Framework Programme for Research and Innovation (2007-2013, 'FP7') and the Research Fund for Coal and Steel (in the European Research Executive Agency), to ensure that the cumulative residual error rate does not exceed 2% by the end of the Framework Programme's management cycle.
- for Horizon 2020, to ensure that the cumulative residual error rate remains within a range of 2-5 % aiming to be as close as possible to 2%.Progress against Horizon 2020 targets is assessed annually based on the results of the implementation of the ex-post audit strategy and taking into account the frequency and importance of the detected errors along with cost-benefit considerations regarding the effort and resources needed to detect and correct the errors.
- for Horizon Europe, to ensure that the cumulative residual error rate does not exceed 2%[21]
- It should be noted, however, that due to its multi-annual nature, the effectiveness of the control strategy of the R&I Family can only be measured and assessed fully in the final stages of the EU Framework Programme, once the ex-post control strategy has been fully implemented, and errors, including those of a systematic nature, have been detected and corrected.

[20] See Point 1.1 of Annex X: Materiality Criteria

[21] No representative error rate for Horizon Europe will be available in 2022 and 2023 as the ex-post audit campaign for the Programme is planned to be launched by the end of 2023, at the earliest.

Due to the COVID-19 pandemic crisis and related travel limitations during 2021, the Common Audit Service (CAS) – in line with the instructions of the Commission – could not carry out the necessary on-the-spot missions and had to postpone some of them. To minimise the impact of COVID-19 on the implementation of the audit campaign, the CAS converted as many traditional audit assignments as possible into desk audits, in line with international best practices and auditing standards.

Despite restrictions and other objective challenges due to the COVID-19 pandemic, the foreseen audit target was achieved. The CAS managed to finalise audits on 514 participations corresponding to 104.3% of the planned most probable scenario for the 2021 target[22].

The following table presents the error rates calculated for the two Framework Programmes by the end of 2021.

	FP7 EX-POST AUDITS	HORIZON 2020 EX-POST AUDITS
REPRESENTATIVE DETECTED ERROR RATE	5.44%	2.29%
CUMULATIVE RESIDUAL ERROR RATE	3.47%	1.67%

Results of the Seventh Framework Programme ex-post audits

The error rates based on the audit work for the Seventh Framework Programme for Research and Innovation on 31 December 2021[23] were:

- Representative detected error rate[24]: **5.44%**[25]

[22] Given the COVID-19 pandemic and related restrictions, the CAS developed several scenarios for the closure of audit targets.

[23] The last Common Representative Sample for the Seventh Framework Programme for DG R&I was launched in 2016. With all Common Representative Sample items closed, the audit strategy for the Seventh Framework Programme was already considered to be fully impl.emented in 2020. The audit coverage for the Seventh Framework Programme is presented in Annex 7.

[24] This is calculated on a multi-annual basis.

[25] This is based on 481 cost statements for which the audit has been completed.

- Cumulative residual error rate: **3.47%** for DG Research and Innovation

The target of cumulative residual error rate of 2% was not attained. Nevertheless, the lessons learned from the Seventh Framework Programme's audits contributed significantly to the development of the enhanced Horizon 2020 control framework.

In 2019[26], a 'de minimis' threshold for financial reservations was introduced stipulating that quantified Annual Activity Report reservations related to residual error rates above the 2% materiality threshold are deemed not substantial for segments representing less than 5% of a DG's total payments and with a financial impact below EUR 5 million. As is the case for the Seventh Framework Programme expenditure[27], a quantified reservation is not required.

Results of the Horizon 2020 ex-post audits

In 2020, the Commission refined its methodology for calculating the Horizon 2020 error rates in line with the European Court of Auditors' observations in its 2018 and 2019 Annual Reports[28]. The methodology applied is described in Annex 5 'Materiality criteria'. As of January 2020, DG R&I applied the revised methodology on a sample of 1 304 audit conclusions. This results in the following error rates for Horizon 2020[29] on 31 December 2021:

- Representative detected error rate: **2.29%**[30]
- Cumulative residual error rate for the Research and Innovation Family DGs: **1.60**% (1.67 % for DG Research and Innovation[31]).

In line with the Financial Statement[32] accompanying the Commission's proposal for the Horizon 2020 regulation, a reservation is not necessary for the related expenditure if the cumulative

[26] Agreement of the Corporate Management Board of 30/4/2019.

[27] FP7 payments represent 0.36% of 2021 R&I payments and the financial impact is EUR 0.66 million.

[28] When calculating the multi-annual error rate, the Commission took into account the results of the audit re-performed by the ECA as part of Module 2 of the DAS 2018-2019.

[29] The Horizon 2020 audit campaign started in 2016. At this stage, four Common Representative Samples with a total of 629 expected results have been selected. By the end of 2021, cost claims amounting to EUR 31.8 billion have been submitted by the beneficiaries to the services. The audit coverage for Horizon 2020 is presented in annex 7. In addition to the Common Representative Samples, Common Risk Samples and Additional Samples have also been selected. The audits of 3 424 participations were finalised by 31/12/2021 (of which 514 in 2021).

[30] Based on the 418 representative results out of the 629 expected in the four Common Representative Samples.

[31] It should be noted that in 2021 most H2020 grants managed by DG R&I were transferred to Executive Agencies. Hence, this figure is based only on the actions that remained with DG R&I at the end of 2021.

[32] The legislative financial statement accompanying the Commission's proposal for the Horizon 2020 regulation states: "The Commission considers therefore that, for research spending under Horizon 2020, a risk of error, on an annual basis, within a range between 2-5% is a realistic objective taking into account the costs of controls, the simplification measures proposed to reduce the complexity of

residual error rate for the programme falls within the target range of 2-5%. In 2021, and despite the above-mentioned caveats, the cumulative residual error rate for Horizon 2020, calculated at 1.67%, more than fulfils this condition and is below the materiality threshold. Despite the absence of reservation, the root causes of errors have been identified and targeted actions taken to address any identified weaknesses.

Since Horizon 2020 is a multi-annual programme, the error rates, and the residual error rate in particular, should be considered within a time perspective. Specifically, the cleaning effect of audits will tend to increase the difference between the representative detected error rate and the cumulative residual error rate, with the latter finishing at a lower value.

These error rates are calculated on the basis of the audit results available when drafting the Annual Activity Report. They should be treated with caution as they may change subject to the availability of additional data from audit results.

The decrease of the error rates in year 2021 could be due, among other reasons, to the beneficiaries' increased knowledge of the eligibility rules and its inherent learning curve, as well as to the results of the communication campaigns, targeted webinars and trainings, addressed in particular to newcomers and SMEs.

Given the results of the audit campaign up until 2020, and the observations made by the European Court of Auditors in its Annual Reports, the Common Implementation Centre, in close cooperation with central Commission services, is defining actions aimed at significantly simplifying the rules, and paving the way for a significant reduction of the error rate in Horizon Europe. Actions were undertaken including further simplification, increased use of simplified forms of funding (including lump sums and unit costs), focused communication campaigns to more "error-prone" types of beneficiaries with higher than average error rates, such as SMEs and newcomers, and enhanced training to external audit firms performing audits on behalf of the Commission (the last three measures also target H2020 grants and beneficiaries). Focusing on the most common errors, these events will be straightforward, reaching more participants and achieving higher impact.

In the context of further reducing the error rates, the Common Implementation Centre will revisit the existing tools for ex-ante controls. It will consult the stakeholders in order to collect their views on possible improvements in the grant management risk module.

Research Framework programmes – specific aspects

rules and the related inherent risk associated to the reimbursement of costs of the research projects. The ultimate aim for the residual level of error at the closure of the programmes after the financial impact of all audits, corrections and recovery measures will have been taken into account is to achieve a level as close as possible to 2%."

The control system of each framework programme is designed to achieve the operational and financial control objectives set in their respective legislative base and legal framework. If the effectiveness of those control systems does not reach the expected level, a reservation must be issued in the annual activity report and corrective measures should be taken.

As each programme has a different control system, the following section details the considerations leading to the establishment of their respective materiality threshold and the conclusions to draw with regard to the declaration of assurance.

Horizon 2020 Framework Programme

The Commission's proposal for the Regulation establishing the Horizon 2020 Framework Programme[33] states that:

It remains the ultimate objective of the Commission to achieve a residual error rate of less than 2% of total expenditure over the lifetime of the programme, and to that end, it has introduced a number of simplification measures. However, other objectives such as the attractiveness and the success of the EU research policy, international competitiveness, scientific excellence and in particular, the costs of controls need to be considered.

Taking these elements in balance, it is proposed that the Directorates General charged with the implementation of the research and innovation budget will establish a cost-effective internal control system that will give reasonable assurance that the risk of error over the course of the multiannual expenditure period is, on an annual basis, within a range of 2-5 %, with the ultimate aim to achieve a residual level of error as close as possible to 2 % at the closure of the multi-annual programmes, once the financial impact of all audits, correction and recovery measures have been taken into account.

Further, this proposal explains also that:

Horizon 2020 introduces a significant number of important simplification measures that will lower the error rate in all the categories of error. However, […] the continuation of a funding model based on the reimbursement of actual costs is the favoured option. A systematic resort to output based funding, flat rates or lump sums appears premature at this stage […]. Retaining a system based on the reimbursement of actual costs does however mean that errors will continue to occur.

An analysis of errors identified during audits of the Seventh Framework Programme (FP7) suggests that around 25-35 % of them would be avoided by the simplification measures proposed. The error rate can then be expected to fall by 1.5 %, i.e. from close to 5 % to around

[33] COM(2011) 809/3 Proposal for a Regulation of the European Parliament and of the Council establishing Horizon 2020 – the Framework programme for Research and Innovation (2014-2020), see point 2.2, pp 98-102.

3.5 %, a figure that is referred to in the Commission Communication striking the right balance between the administrative costs of control and the risk of error.

The Commission considers therefore that, for research spending under Horizon 2020, a risk of error, on an annual basis, within a range between 2-5 % is a realistic objective taking into account the costs of controls, the simplification measures proposed to reduce the complexity of rules and the related inherent risk associated to the reimbursement of costs of the research project. The ultimate aim for the residual level of error at the closure of the programmes after the financial impact of all audits, correction and recovery measures will have been taken into account is to achieve a level as close as possible to 2 %.

In summary, the control system established for Horizon 2020 is designed to achieve a control result in a range of 2-5% detected error rate, which should be as close as possible to 2%, after corrections. Consequently, this range has been considered in the legislation as the control objective set for the framework programme.

The question of being on track towards this objective is to be (re)assessed annually, in view of the results of the implementation of the ex-post audit strategy and taking into account both the frequency and importance of the errors found as well as a cost-benefit analysis of the effort needed to detect and correct them.

Horizon Europe Framework Programme

For Horizon Europe, the general control objective, following the standard quantitative materiality threshold proposed in the standing instructions for Annual Activity Reports, is to ensure that the cumulative residual error rate, i.e. the level of errors which remain undetected and uncorrected, does not exceed 2%[34]

De minimis threshold for financial reservation

As of 2019, a 'de minimis' threshold for financial reservations is introduced. Quantified AAR reservations related to residual error rates above the 2% materiality threshold, are deemed not substantial for segments representing less than 5% of a DG's total payments and with a financial impact below EUR 5 million. In such cases, quantified reservations are no longer needed.

[34] No representative error rate for Horizon Europe will be available in 2022 and 2023 as the ex-post audit campaign for the Programme will start at the earliest end of 2023