BRIEFING

EU Legislation in Progress

European Parliament

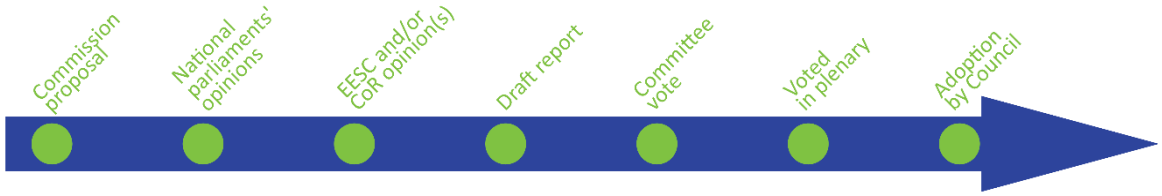
# European high-performance computing joint undertaking

## OVERVIEW

Following a declaration made by seven EU Member States in March 2017, the European Commission adopted a proposal to establish a joint undertaking for high-performance computing (HPC) under Article 187 of the Treaty on the Functioning of the European Union (TFEU) on 11 January 2018. The proposed regulation would establish the joint undertaking for the period to 31 December 2026, and provide it with €486 million in EU funds from the Horizon 2020 and Connecting Europe Facility programmes as well as an equivalent contribution from the participating countries.

The joint undertaking would be charged with the joint procurement of two pre-exascale supercomputers for the Union. It would also implement an HPC research and innovation programme to support the European HPC ecosystem in developing technologies to reach exascale performance by 2022-2023. The European Parliament, adopted its opinion during the July 2018 plenary session, and the Council adopted the text on 28 September 2018. The Council Regulation was published in the Official Journal of 8 October and entered into force on 28 October 2018.

| **Proposal for a Council regulation on establishing the European High-Performance Computing Joint Undertaking** | | |
|---|---|---|
| *Committee responsible:* | Industry, Research and Energy (ITRE) | COM(2018) 8<br>11.1.2018 |
| *Rapporteur:* | Zigmantas Balčytis (S&D, Lithuania) | 2018/0003(NLE) |
| *Shadow rapporteurs:* | Michał Boni (EPP, Poland); Evžen Tošenovský (ECR, Czech Republic); Fredrick Federley (ALDE, Sweden); Neoklis Sylikiotis (GUE/NGL, Cyprus); Jakop Dalunde (Greens/EFA, Sweden); Dario Tamburrano (EFDD, Italy); Barbara Kappel (ENF, Austria) | Consultation procedure – Parliament adopts only a non-binding opinion |
| *Procedure completed.* | Council Regulation (EU) 2018/1488<br>OJ 252, 8.10.2018, pp. 1–34 | |



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# Introduction

In March 2017, seven Member States signed a declaration agreeing to work towards the establishment of a cooperation framework called EuroHPC Joint undertaking (EuroHPC JU), aiming to help the EU regain leadership in high-performance computing (HPC). In this declaration, the Member States invited the European Commission to join the initiative. In May 2017, the Commission announced its intention to propose a legal instrument to provide a framework to implement this initiative. Following an impact assessment, the Commission concluded that a joint undertaking under Article 187 TFEU was the best option to achieve the objectives of EuroHPC and adopted its legislative proposal.

# Context

## Supercomputers and the HPC ecosystem

Computer simulations and big data analysis today permeates all areas of scientific research and industrial development, such as designing new materials for energy applications, modelling the evolution of the climate, testing new drugs, reproducing the condition of the 'Big Bang', or developing encryption technologies. For such applications, researchers and engineers need access to HPC systems that can operate a million times faster than desktop computers. The growing role of HPC makes it a strategic resource for maintaining scientific leadership, industrial competitiveness and national security in a context where to out-compute is to out-compete.

Supercomputers are based on hundreds of thousands of processors working in parallel. A key aspect of their design is that the architecture of the machine – the type of processors and the way they are connected with each other – as well as the software to run the machine need to be tailor-made to the type of tasks that the machine will perform. In order to get the best efficiency, all the actors of the HPC ecosystem, from the technology supply chain of electronic components to the development of applications, need to be involved to co-design supercomputers. The full value-chain of HPC – hardware, software, applications, skills, services and interconnections – must be supported, in order to be able to design and operate supercomputers with the highest benefits.

## Current challenges in HPC

The growth in the use of HPC by researchers and engineers and by the public and private sector creates strong pressure to develop computational resources and computing power, leading to a global race for computing leadership. The best supercomputers worldwide currently exceed the petascale performance (1 million billion operations per second). The exascale performance (a thousand times faster, 1 billion billion operations per second) is expected to be reached in the beginning of the 2020s.[1] This accelerated evolution means that supercomputers become obsolete in about five years, as upgrading them becomes more expensive than replacing them with new machines.

From a technological perspective, this race implies several challenges be addressed. As supercomputers consume a lot of energy and require permanent cooling to operate, the next generation of exascale supercomputer requires technological breakthroughs on low-power processing units and systems to address these issues.

## EU dependence on foreign HPC suppliers

In November 2017, the EU had none of the 10 most powerful supercomputers worldwide and only 4 of the top 20 supercomputers. This situation has constantly deteriorated since 2012, when the EU possessed 4 of the top 10 supercomputers. Moreover, the best supercomputers in Europe are supplied by non-EU vendors and are based on non-EU technology. Overall the EU industry provides around 5 % of HPC resources worldwide, whereas it consumes 29 % of these resources.[2]

The USA, China and Japan all consider HPC as a strategic priority and are developing indigenous HPC supply chains and ecosystems to avoid dependency on foreign suppliers. These three countries host nine of the ten fastest supercomputers, with China possessing the two fastest.[3] The USA and China restrict the development and procurement of HPC machines to domestic suppliers, limiting EU suppliers' access to foreign markets.

Dependence on foreign technology and suppliers might deprive the EU of access to the latest HPC technology. This dependence is also problematic given that it limits the possibility to co-design tailor-made machines for specific applications. It is also a threat to maintaining the necessary skills throughout the HPC supply chain to be able to operate supercomputers efficiently.

Besides HPC hardware dependency on foreign suppliers, the current EU offer in HPC capacities does not satisfy the demand from the scientific and industrial communities. EU researchers and engineers turn to supercomputers outside the EU, particularly in the USA, to obtain computing time to run their applications. This poses problems regarding the protection of data processed outside the EU and of commercial trade secrets. It also means there is a risk that access to foreign HPC capacities might be reduced, leading to a delocalisation of industries or a 'brain drain' among scientists.

The gap between the EU and its competitors is attributed in part to a lack of EU and Member State investment in HPC. A 2015 European Commission study showed the EU underinvestment in this field creates an annual gap of €700 million, compared to the USA.

# Existing situation

## A fragmented EU landscape

EU Member States acquire supercomputers according to national strategies that remain uncoordinated at EU level. Each Member State manages its own capacities in HPC and updates its infrastructure based on its own needs. In 2009, four Member States – France, Italy, Spain and Germany – decided to launch a partnership for advanced computing in Europe (PRACE) as an international association. Under PRACE, these four hosting members (joined by Switzerland in 2016) opened-up access time to some of their national supercomputers to researchers from 25 European countries who are members of PRACE. The allocation of computing time is based on a process of peer-review of the proposals made biannually by the researchers from the participating countries. The non-hosting countries support part of the operational costs of the supercomputers. Nevertheless, HPC infrastructures involved in PRACE are still owned by the Member States and no framework at EU level exists for the joint procurement of supercomputers.

## The fragmented EU financial intervention in HPC

The EU supports the HPC ecosystem development through the Horizon 2020 framework programme for research and the Connecting Europe Facility (CEF). Under Horizon 2020 the EU funds services offered to PRACE users. It is also a main funder of GEANT, the structure that provides pan-European connectivity between national research networks. The GEANT network ensures end-users of supercomputers are connected with HPC centres throughout Europe, and collaborates closely with PRACE.

In 2013, the European technology platform for HPC (ETP4HPC), representing public and private research institutions and users of HPC systems, was established with the aim of building a competitive value-chain for HPC in Europe. The ETP4HPC became the association representing the private sector when the contractual public-private partnership (cPPP) on HPC was established under Horizon 2020, with a ring-fenced budget of €700 million for the period 2014-2020. The central objective of the cPPP is to establish and implement a research programme for the development of the technologies required to reach exascale performance.

The input of the HPC cPPP for Horizon 2020 work programmes led to the creation of European centres of excellence, seeking to widen the use of HPC in various domains of application, such as

biomolecular, energy, or material research. The ETP4HPC works intensively with the Big Data Value Association (BDVA), an industry-driven association representing the private interests in the Big Data cPPP (created in 2014 with a ring-fenced budget of €500 million under Horizon 2020 for the period 2016-2020).

EU funding for HPC is divided between two programmes, and the funding under Horizon 2020 is allocated under three parts of the programme: infrastructures; Leadership in Enabling and Industrial Technologies (LEIT); and the Future Emerging Technologies (FET). The work programmes for these parts are adopted by different configurations of the programme committee. This fragmentation of EU funding limits the coordination of the different initiatives and their impact.

## The evolution of the European HPC strategy

To address the fragmentation of the HPC landscape in Europe, in 2006 an expert report called for HPC to become a 'strategic priority in Europe' to develop petascale performance supercomputers. In 2009, the Commission invited Member States 'to strengthen their collaboration in planning, implementing and sharing infrastructures' in HPC. A new step towards EU coordination was taken in 2012 with the Commission adopting a European HPC strategy, aiming for 'the EU to re-engage in HPC and to strive for leadership'. This strategy entailed the acquisition of world class infrastructures, the objective to have independent access to HPC technologies systems and services, and the establishment of a pan-European governance scheme in HPC.

In April 2016, the development of the HPC ecosystem was included in the European data infrastructure pillar[4] of the European cloud initiative,[5] under the digital single market strategy adopted in 2015. The Commission noted at that time that 'no single Member states alone has the financial resources to develop the necessary HPC ecosystem'. It set an objective of 'realising exascale supercomputers around 2022, based on EU technology, which would rank in the first three places in the world'.

Following the adoption of the EuroHPC declaration, the Commission announced in a communication on the midterm review on the implementation of the digital single market strategy, its intention to 'explore how to set up a framework to support the development of a pan-European HPC and data infrastructure'. The Commission declared its intention to 'propose, by end-2017, a legal instrument that provides a procurement framework for an integrated exascale supercomputing and data infrastructure'.

# Parliament's starting position

In its resolution of 19 January 2016 on 'Towards a Digital Single Market Act', the European Parliament called on the Commission to set up an action plan leading to the establishment of the European Open Science Cloud that 'should integrate existing networks, data and high-performance computing systems and e-infrastructures services across scientific fields, within a framework of shared policies, standards and investments'.

In its resolution of 16 February 2017 on the European cloud initiative, Parliament noted the lack of HPC capacity in Europe. It stressed that the EU was 'lagging behind in the development of HPC as a result of its under-investment in establishing a complete HPC system, when countries like the USA, China, Japan and Russia are seriously investing in such systems, making them a strategic priority, with national programmes to develop them'. The Parliament also believed 'that Europe needs a complete HPC ecosystem to acquire leadership-class supercomputers, secure its HPC system supply and provide HPC services to industry and SMEs' and 'that it is of upmost importance for the EU to rank among the top supercomputing powers in the world by 2022'.

# Council starting position

In its 2009 conclusions on the future of ICT research, innovation and infrastructures, the Council of the EU invited Member States 'to intensify their efforts in building research and innovation clusters in ICT through more coordinated investments in research infrastructures in critical areas such as high-performance computing'.

In May 2013, the Council adopted its conclusions regarding the 2012 Commission communication on the European HPC strategy. It stressed the strategic importance of HPC 'to the EU's industrial and scientific capabilities as well as its citizens'. The Council recognised 'the need for an EU-level policy in HPC addressing the entire HPC ecosystem' and 'the need for all relevant actors, public and private, to work in partnership'. It also asked 'the Commission to explore funding possibilities and instruments to support the development of leadership-class HPC capabilities in Europe as well as the acquisition of world-class HPC systems on the global market on the basis of open competition to address the needs of various HPC user communities'.

Four Member States (Italy, France, Luxembourg, and Spain) adopted a European strategic positioning paper on the intention of these countries 'to apply for an Important Project of Common European Interest on High-Performance Computing and Big Data enabled Applications' in November 2015. This initiative was backed by the European Council in its June 2016 conclusions, as it called for progress in 'coordinating EU efforts on HPC'.

In March 2017, seven Member States[6] signed a declaration for a cooperation framework on HPC called EuroHPC 'for acquiring and deploying an integrated exascale supercomputing infrastructure'. The implementation roadmap of the initiative is to include the 'procurement processes for the acquisition of two world-class pre-exascale supercomputers preferably starting on 2019-2020, and two world-class full exascale supercomputers preferably starting on 2022-2023', with 'the development of high-quality competitive European technology'. By June 2018, the EuroHPC declaration had been signed by 16 European countries.[7]

# Preparation of the proposal

In August 2017, the Commission published an inception impact assessment (IA) for a European initiative on HPC. The Commission conducted a one-month targeted consultation from 3 August to 5 September 2017, and held other meetings and workshops with stakeholders in 2017. The public consultation period was shorter than the typical 12 weeks, which might explain why the number of respondents was low for some questions.[8]

The results of the consultation demonstrate the identification of issues by stakeholders: the limited interaction between industry and academia in the field, the deep fragmentation of HPC programmes and efforts in Europe, and the EU dependence on foreign suppliers. Some 83 % of the respondents were in favour of EU intervention going beyond the current actions, to improve the EU coordination and cooperation of HPC initiatives.

The IA taking into account the results of the public consultation, as well as of a 2015 Commission study on the implementation of the European HPC strategy, concluded that the establishment of a joint undertaking under Article 187 TFEU was the best option to implement the two pillars of the European initiative in HPC: the joint procurement of supercomputers and the definition and implementation of a research programme in HPC. The other main policy options considered – an intergovernmental organisation, a European research infrastructure consortium (ERIC), or of a European economic interest grouping (EEIG) – would not be suitable for all aspects of the initiative.

In terms of its sustainability, the IA did not consider what will happen after this instrument runs out in 2026. Though the IA explained that the HPC acquired might get outdated after five years.

The Regulatory Scrutiny Board (RSB) of the European Commission examined the draft Impact Assessment on 25 October 2017 and issued a positive opinion with reservations and recommendations to be considered.[9]

# The changes the proposal would bring

The proposed regulation would establish a joint undertaking[10] for HPC under Article 187 TFEU with a total EU contribution of €486 million funded by the reallocation of Horizon 2020 and Connecting Europe Facility programmes funds already committed for HPC under the current MFF.[11] Participating states[12] are expected to provide an equivalent €486 million contribution to the initiative, and the private entities, as part of their commitment in the HPC and big data cPPPs, should provide an estimated €422 million.[13] The EuroHPC JU is to be established in Luxembourg in November 2018 and will run until end-2026.

## Objectives and implementation of the joint undertaking activities

The main objectives would be to provide scientists, industry and the public sector from the EU or Horizon 2020 associated countries with the latest HPC and data infrastructure, as well as supporting the development of its technologies and applications; to provide a framework for acquisition of an integrated world-class pre-exascale supercomputing and data infrastructure in the EU; to provide EU level coordination and adequate financial resources to support the development and acquisition of such infrastructure; and to support the development of an integrated HPC ecosystem in the EU.

The joint undertaking would reach its objectives by implementing actions on two pillars:

- Procurement and operation of HPC and data infrastructure. The JU would acquire two pre-exascale supercomputers and provide financial support to the acquisition of at least two petascale supercomputers under public procurement of innovative solutions. The JU would own the pre-exascale machines but would entrust the operation of these machines to a hosting entity situated in a participating state.
- Definition and implementation of a HPC research and innovation programme to support the development of the next generation of HPC technologies and systems towards exascale performance, covering the full HPC ecosystem and value-chain. This research programme would be complemented by action supporting HPC applications, raising awareness on HPC, skills development and outreach activities.

The acquisition of the two pre-exascale machines is planned for 2020, following the process of selecting the hosting institutions. The hosting institution should be an institution of one of the participating states with experience in operating HPC infrastructures. It would be selected by the governing board of the JU based on an open competition. Given that the machines would become obsolete after about five years, the property of the machines could be transferred to the hosting institution after four years of operation, following the payment of the residual value of the supercomputer to the JU. This implies that the JU would own no infrastructure on its closing date in 2026.

Regarding the first pillar, the EU financial contribution may only be used to cover the cost of acquisition of the machines. The operational costs would have to be covered by the participating states. Access to the jointly procured supercomputers would be limited mainly to research and innovation projects under public funding programmes. A maximum of 10 % of the computing time could be allocated to commercial services. The access time will be proportional according to the financial contribution made by the EU and the participating states to the acquisition and operation cost of the supercomputers. Each participating state would manage attribution of its own share of the access time. The governing board of the JU would define access rights to the EU share.

Regarding the second pillar, the JU research and innovation programme would replace the HPC research and innovation programme conducted in the framework of the HPC cPPP within

Horizon 2020. The research and innovation projects would be launched between 2019 and 2021, and be completed by 2026. The private contribution would be used to co-finance the research and innovation programme.

The proposed EuroHPC JU does not include the joint procurement of exascale supercomputers whose development would result from the progress made under the HPC research and innovation programme. Such joint procurement of exascale supercomputers, expected to be included as an objective for 2022-2023 in the EuroHPC declaration, would have to be supported under the next multi-annual financial framework. In fact, under the post-2020 MFF programme'Digital Europe', published on 6 June 2018, EuroHPC JU is included as one of five priorities.

### Governance of the joint undertaking

To avoid conflicts of interest in the procurement of the pre-exascale machines, the governing board of the JU would be composed only of representatives from the public-sector members: the Commission representing the EU (with 50 % of the voting rights), and the representatives of the participating states. The participating states' voting rights would differ according to the type of tasks. Voting rights for administrative tasks would be based on the share of the participating state financial commitment for the duration of the JU. Voting rights regarding the implementation of the activities would differ for each pillar and would be calculated yearly, in proportion to the actual financial or in-kind contributions made by the participating state for the given pillar since the establishment of the JU. No financial contribution to one of the pillars would result in no voting rights on the corresponding decisions. It is not specified how in-kind contributions will be considered.

The private-sector members would be represented on an Industrial and Scientific Advisory Board, with an Infrastructure Advisory Group providing advice for the procurement and operation of the supercomputers and a Research and Innovation Advisory Group in charge of drawing up a research agenda on HPC technologies and applications. ETP4HPC and BDVA have been selected to participate in the JU.

## Advisory committees

The European Economic and Social Committee (EESC) adopted an opinion on the proposed regulation on 23 May 2018. It supports the initiative though considers starting investment of €1 billion for the acquisition of supercomputing machines is not very ambitious compared to the USA and China plans. Thus it asks for a similar financial effort in the next MFF in line with our global competitors. It also asks for an industrial approach for developing the next generation of low-power microchips in Europe, to make it less dependent on imports, and to secure access to top HPC technology.

The EESC would like more Member States to join the initiative, and to this end asks the Commission to raise awareness of the advantages and opportunities of this legal instrument, in particular for smaller countries, and with regard to the possibility of making in-kind contributions. It also welcomes the fact that two of the Commission's partners could be private-sector members, as it wishes to see the participation of industry, including SMEs. However it asks that, for any new private-sector partner, in particular for those from outside the EU, that reciprocity be fulfilled. For instance in 2017 about 14 % of the 88 ETP4HPC members are from the US, China and Japan.

The European Committee of the Regions (CoR) was not consulted on the proposal.

## National parliaments

As the proposal does not aim at the adoption of a 'legislative act', there is no formal consultation of the national parliaments. Nonetheless, national parliaments may still wish to make observations on the proposal. The Czech Senate adopted a resolution on 4 April 2018 in which it supports the

country's involvement in this initiative. Since then it has signed the EuroHPC declaration and thus became one of the 16 participating countries.

## Stakeholder views

*This section aims to provide a flavour of the debate and is not intended to be an exhaustive account of all different views on the proposal. Additional information can be found in related publications listed under 'EP supporting analysis'.*

To date, no major stakeholder has issued a position on the Commission proposal.

## Legislative process

Within the European Parliament, the file was assigned to the Committee on Industry, Research and Energy (ITRE), rapporteur Zigmantas Balcytis (S&D, Lithuania). The budget Committee (BUDG) was asked for an opinion but decided not to submit one.

The draft report was published on 28 March 2018 and was presented in the ITRE Committee on 24 April. The amendments tabled in committee were published on 3 May, which resulted in 22 compromise amendments. The report was adopted in the ITRE committee on 19 June with 58 votes in favour, 1 against and 2 abstentions. It is expected that the Parliament will vote on the report during the July plenary session.

The report supports the creation of the EuroHPC JU, and aims at broadening the access to the supercomputers to other players, such as SMEs, start-ups and non-participating Member States. To this end it also highlights the creation of High Performance Computing Competence Centres in each Member State,14 which should facilitate and promote access to the HPC ecosystem. They should also provide learning and training courses for building HPC skills and should promote awareness-raising and training and outreach activities for SMEs.

It also recommends that all EuroHPC JU users must comply with EU law in particular on data protection and privacy, and intellectual property rights, whether they are located in the EU or not.

It also specifies that the initiative should have an exclusive focus on civil research as funding comes partly from the Horizon 2020 programme.[15] It may, however, be noted that the European Commission has highlighted that HPC is also essential for national security and defence research, for example in developing complex encryption technologies and improving the EU cybersecurity capacity to detect terrorist and other cyber-attacks.[16]

The report also calls on the Commission and the Member States to strengthen the existing work of the European Cloud Partnership, based on the existing pillars of PRACE and GEANT, and avoid any conflict of interest, and recognise their complementary roles.

The Research working party of the Council discussed a draft general approach on 18 June 2018. It develops further the conditions and statutes of the joint undertaking. For instance it proposes that the time allocated should be proportionate to the financial contributions for the participating members, though for instance it does not explain how in kind contributions will be considered.

It also highlights that the MFF Digital Europe programme will have an action on this. In fact the Joint Undertaking is expected to draw budget from both Digital Europe and Horizon Europe after 2020.

The Council approved the general approach on 25 June. Since the Parliament was only consulted on this proposal, in practice the Council was able to move immediately to formal adoption of the regulation once Parliament had adopted its opinion, which it did on 3 July 2018 in plenary session, by 599 votes to 37, with 39 abstentions. Thus the Council adopted the text on 28 September 2018, and it entered into force on 28 October 2018.

By 30 June 2022, the Commission will carry out an interim evaluation of the EuroHPC JU, the results of which will be sent to the European Parliament and to the Council by 31 December 2022. Within

six months and two years after the winding-up of the EuroHPC JU, the Commission shall conduct a final evaluation and present its results to the European Parliament and to the Council.

## EP SUPPORTING ANALYSIS

Negreiro M., Developing supercomputers in Europe, EPRS, European Parliament, October 2017.
Reillon V., Public-private partnerships in research, EPRS, European Parliament, May 2017.
Reillon V., Contractual public-private partnerships in research, EPRS, European Parliament, May 2017.
Reillon V., European Technology Platforms, EPRS, European Parliament, May 2017.
Reillon V., Joint Technology Initiatives, EPRS, European Parliament, May 2017.
Reillon V., Horizon 2020 budget and implementation, EPRS, European Parliament, November 2015.
Reillon V., EU framework programme processes, EPRS, European Parliament, January 2018.

## OTHER SOURCES

European high-performance computing joint undertaking, European Parliament, Legislative Observatory (OEIL).

## ENDNOTES

1 The computing power of supercomputers is measured in floating point operations per second (flops). Current top machines operate at 100 petaflops ($10^{15}$ flops). Next generation machines will operate at a few exaflops ($10^{18}$ flops).

2 The element presented in this section comes from the impact assessment accompanying the proposal and the 2016 Commission document on the implementation of the European HPC strategy.

3 The third supercomputer in the ranking is owned by Switzerland.

4 The European data infrastructure integrates three components: data infrastructure for storage and management, high-bandwidth networks and powerful computers to process the data (HPC systems).

5 The other two pillars of the European cloud initiative are the establishment of the European open science cloud and the development of awareness-raising activities for cloud usage.

6 Germany, Portugal, France, Spain, Italy, Luxembourg and the Netherlands.

7 Germany, Portugal, France, Spain, Italy, Luxembourg, the Netherlands, Belgium, Slovenia, Bulgaria, Switzerland, Greece, Croatia, Cyprus, Czech Republic and Poland.

8 For instance the IA talks about 92-96 replies and provides an analysis of them (Annex 2, Part 1, p. 4), and later about 15 replies are analysed in Annex 2, Part 2, p. 5-6.

9 See annex 1, of the impact assessment, SWD(2018) 6 final

10 Joint undertakings under Article 187 TFEU are already established as the legal entity managing the Joint Technology Initiative or the SESAR initiative under Horizon 2020.

11 Out of this contribution, €100 million would come from the Connecting Europe Facility, with €386 million from the Horizon 2020 budget representing the remaining of the ring-fenced budget for the HPC cPPP for 2019-2020, and a contribution from the ring-fenced budget of the big data cPPP for the same period.

12 16 countries have signed the EuroHPC declaration to date (as per note 8). Other Member States or countries associated to Horizon 2020 are invited to participate at any time in the JU.

13 According to the Commission's estimate but note that this amount is not included in the proposed regulation

14 It should be noted that the Commission is also planning cybersecurity competence centres in each Member State that will use HPC for the analysis of large quantities of data; see the revised EU cybersecurity strategy JOIN(2017) 450 (p. 9).

15 According to Article 19(2). H2020 'research and innovation activities carried out under horizon 2020 shall have an exclusive focus on civil applications'

16 For instance, according to the IA, citizens would benefit from improved defence and cybersecurity due to the development of HCP (p. 22). It also mentions that development of HPC is a matter of national security, especially in the markets of the third countries, which is why European vendors face competition problems (p. 19).

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