European Commission

Leading the way in European Supercomputing

A PROJECTS INFO PACK BY CORDIS

Research and Innovation

FOREWORD

"By joining the forces of many different partners, the EuroHPC Joint Undertaking aims to place Europe in a leading position in the global supercomputing race. The world-class supercomputing ecosystem developed by the EuroHPC JU is improving citizens' quality of life, advancing science and boosting the innovation potential of enterprises."

Anders Dam Jensen
Executive Director of the EuroHPC Joint Undertaking

Supercomputers are advanced systems with extremely high computational capabilities. They are able to solve problems and perform calculations which require more speed and power than traditional computers are capable of.

High Perfomance Computing (HPC) services offered by supercomputers are critical for discovering new drugs, speeding up the diagnosis and treatment of diseases, anticipating severe weather conditions, increasing cybersecurity and developing more sustainable products.

The European High Performance Computing Joint Undertaking (EuroHPC JU) is a joint initiative created in 2018. It pools together the resources of the European Union, 31 European countries and three private partners with the ambition of making Europe a world leader in supercomputing.

To this end, the EuroHPC JU is procuring and installing supercomputers across Europe. No matter where in Europe they are located, European scientists and users from the public sector and the industry can benefit from these EuroHPC supercomputers, which rank among the world's most powerful. In parallel, the EuroHPC JU is funding an ambitious research and innovation programme to develop a full European supercomputing supply chain: from processors and software to applications to be run on these supercomputers and know-how to develop strong European expertise.

In this specially commissioned Projects Info Pack, you'll discover nine selected EuroHPC JU projects that are promoting green computing and contributing to the technological and digital autonomy and leadership of Europe.

EuroHPC
Joint Undertaking

EDITORIAL

Supercomputers are already changing the lives of European citizens. Machines many thousands of times more powerful than a desktop computer are making breakthroughs in climate modelling, personalised medicine, energy-saving strategies and epidemic control. This Projects Info Pack showcases the recently created European High Performance Computing Joint Undertaking (EuroHPC JU) and its work in developing Europe's supercomputer capabilities.

No European country has the capacity to develop world-class supercomputing resources individually. Cooperation, knowledge-sharing and the pooling of resources at European level are essential. The EuroHPC JU brings together the resources and expertise of 31 European countries and partners to build a leading European supercomputing ecosystem. The aim is to offer every participating country more opportunities than they would otherwise have, and lead the way in the global supercomputing race.

Since its creation in 2018, the Joint Undertaking has substantially increased overall investments in HPC at European level and has started to restore Europe's position as a leading HPC power globally. The Joint Undertaking is not only procuring supercomputers, but investing in research to develop innovative and competitive supercomputing technologies, applications, skills and expertise, based on a supply chain that will reduce Europe's dependency on foreign manufacturers.

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From the initial 29 research projects currently managed by the EuroHPC JU, this Projects Info Pack highlights nine that reflect the diverse range of topics addressed by the Joint Undertaking.

A central objective of the Joint Undertaking is developing innovative, homegrown and sustainable HPC technologies, such as the development of a low-power microprocessor **(EPI SGA2)**, a platform for users to submit complex simulation requests to HPC data centres **(HEROES)**, and a unique incubator for quantum-HPC hybrid computing **(HPCQS)**.

Another objective of the EuroHPC JU is to develop applications, algorithms and software to be run on the supercomputers by public and private users. These include drug design **(LIGATE)**, disease modelling **(MICROCARD)** and aerospace engineering **(NextSim)**, as well as energy, climate research and more.

A third objective is to develop the skills needed to widen the use of HPC for a larger number of public and private users, wherever they are located in Europe.

EuroCC is creating a network of national HPC Competence Centres to ease access to European HPC opportunities in different sectors, while **FF4EuroHPC** supports SMEs which want to benefit from the use of HPC services to develop innovative products and services. Finally, **EUMaster4HPC** has set up a pioneering pan-European HPC Master of Science programme to educate the next generation of HPC experts across Europe.

Currently, five EuroHPC JU supercomputers are operational in Bulgaria, Czechia, Finland, Luxembourg and Slovenia. The construction of an additional three supercomputers is under way in Italy, Portugal and Spain, with more systems planned for the near future. The investment delivered by the Joint Undertaking is of critical importance in developing a world-class supercomputing ecosystem in Europe, which will boost European competitiveness and innovation, and improve the quality of life of European citizens.

The EuroHPC Joint Undertaking

The European High Performance Computing Joint Undertaking was established on 28 September 2018 by Council Regulation (EU) 2018/1488, and is currently regulated by Council Regulation (EU) 2021/1173. Drawing together countries, industry and public bodies to lead the way in European supercomputing, the EuroHPC JU has a combined budget of EUR 7 billion, drawn from the Digital Europe Programme, Horizon Europe, and Connecting Europe Facility 2.0 as well as contributions from participating countries and private members.

Supercomputers are vital tools needed to meet Europe's climate, energy and transport goals. They are also essential for national security, defence and sovereignty. The EuroHPC JU complements the aims of the European Chips Act to boost Europe's competitiveness and resilience in semiconductor technologies and applications, as chips are critical components of a supercomputer.

A central objective of the EuroHPC JU is to promote green and sustainable technologies as part of the EU's goals of carbon neutrality laid out in the European Green Deal. It is building some of the world's greenest supercomputers, drawing on technologies such as water cooling, waste heat recycling and next-generation energy-efficient microprocessors.

The EuroHPC JU contributes to the EC priority A Europe fit for the digital age, which aims to make the digital transition work for people and businesses.

Upgrading Europe

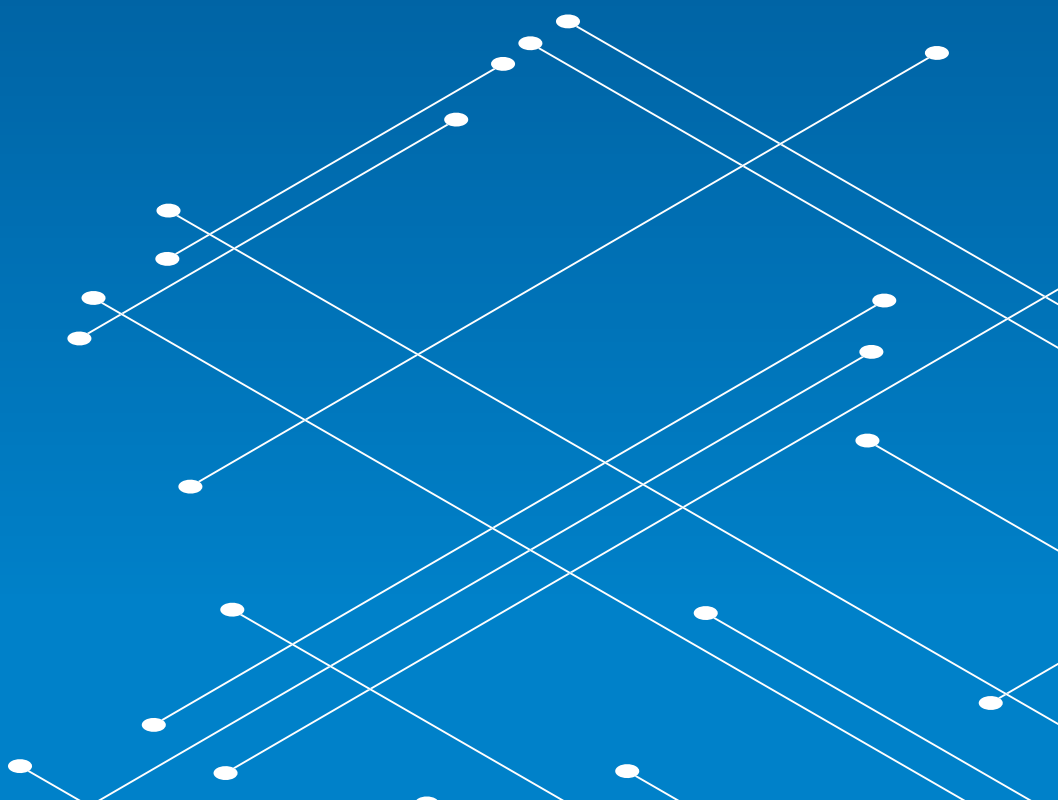
Quick, think of a number. Now multiply it by 7. That sort of mental arithmetic is exactly what a computer does, except it can juggle numbers 19 digits long. And a supercomputer can perform trillions of these floating-point operations (or FLOPs) at once. One hundred top-of-the-line laptops working together might be able to achieve a single petaflop (*), and Europe's supercomputers are significantly more powerful than that. When all eight EuroHPC systems are operational, the EuroHPC JU will provide 876 petaflops to European users. By the end of 2023, this will more than double to 1 950 petaflops with the introduction of the first exascale system and further mid-range supercomputers.

(*) One petaflop equals 1 000 000 000 000 000 calculations per second.

Numbers indicate the amount of petaflops available.

Source data: EuroHPC JU

BUILDING THE FUTURE



"The information technology being developed by the project will place Europe at the vanguard of quantum computing."

Kristel Michielsen, HPCQS project coordinator

PROJECT ID CARD

Full name: High Performance Computer and Quantum Simulator hybrid

Project dates: 1 December 2021 – 30 November 2025

Coordinated by: Jülich Research Centre in Germany

Funded under: Horizon 2020-LEIT-ICT

CORDIS factsheet: cordis.europa.eu/project/id/101018180

Project website: hpcqs.eu

Total budget: EUR 12 000 000

EU contribution: EUR 6 000 000

HPCQS

Preparing Europe for a future of quantum computing

Sometimes even a supercomputer isn't super enough to get the job done. That's why this EU-funded project is making the leap towards quantum computing.

Across industry and science, there is an array of essential computing tasks that classical supercomputers struggle to solve. Examples of such complex problems include the optimisation of traffic flows and fundamental numerical problems in chemistry and physics for the development of new drugs and materials.

That's where quantum computing can help.

"The system and application-oriented development of quantum computing opens the door to new approaches to solving these hard-to-compute problems," explains Kristel Michielsen, a professor at the Jülich Research Centre in Germany. "Because many of these problems have important research and economic consequences, there's a sense of urgency that currently surrounds quantum computing."

With the support of the EU-funded HPCQS project Michielsen is leading an effort to prepare European research, industry and society for a future of quantum computing. "The project is developing, deploying and coordinating a federated, European quantum computing infrastructure," she says.

To build this infrastructure, HPCQS, part of the EuroHPC Joint Undertaking, is using what are called quantum simulators, or QS. "A QS can be viewed as an analogue version of a quantum computer that, because it does not require complete control of each individual component, is simpler to build," notes Michielsen.

The project will procure and coordinate two pilot QS – each capable of controlling over 100 qubits – one located at GENCI/CEA in France and the other at the Jülich Supercomputing Centre. The two sites will integrate the QS into their respective data centres and operate them throughout their lifetime. Special attention will be given to understanding if essential HPC services can be shared. Researchers will also study the effective utilisation of the QS by scientists and engineers.

"The information technology being developed by the project will place Europe at the vanguard of quantum computing," concludes Michielsen. Once finalised, the HPCQS infrastructure will be made readily available via the cloud to public and private European users on a non-commercial basis.

"EPI SGA2 will be a huge step towards equipping the EU with its own world-class supercomputing technology."

Etienne Walter, EPI general manager

PROJECT ID CARD

Full name: SGA2 (Specific Grant Agreement 2) OF THE EUROPEAN PROCESSOR INITIATIVE (EPI)

Project dates: 1 January 2022 – 31 December 2024

Coordinated by: Atos (Bull S.A.S.) in France

Funded under: Horizon 2020-Science with and for Society

CORDIS factsheet: cordis.europa.eu/project/id/101036168
(this page will be available soon on the CORDIS website)

Project website: european-processor-initiative.eu

Total budget: EUR 70 000 000

EU contribution: EUR 35 000 000

EPI SGA2

Building Europe's high performance computing capabilities

With the development of new processors and accelerators, this EU-funded project aims to equip the EU with its own world-class supercomputing technology.

Because HPC has the capability to process extreme-scale simulations that are simply impossible to do with a single system, it has the power to transform research and business.

Building the supercomputers we need to tackle these challenges requires a range of complex components. Delivering these materials requires a robust digital supply chain which currently doesn't exist.

"Europe needs to grow its ability to develop HPC components, especially high-end processors," explains Etienne Walter from Atos France. "Otherwise, we will continue to depend on foreign imports, which not only raises security and sovereignty concerns, but also impacts the European balance of payments, and the competitiveness of European industry."

Projects like the European Processor Initiative (EPI), on which Walter serves as general manager, are helping to build Europe's HPC capabilities. During its first phase, the project designed and developed a new family of low-power processors, including a general-purpose processor and accelerators.

"Our innovative processors are crucial elements to build supercomputers and provide the performance demanded by HPC applications, as well as big data and machine learning applications," says Walter. "Furthermore, our accelerators provide the much-needed energy efficiency for future exascale systems."

In the second phase of the project, which is funded by the EuroHPC Joint Undertaking, researchers aim to advance their processors towards market readiness. To do so, they aim to validate the first-generation processors and develop an even more powerful second-generation version.

By the end of this second phase, Walter expects the high-end processor to be ready for use in the data centres that serve HPC applications.

"Achieving this will be a huge step towards equipping the EU with its own world-class supercomputing technology," concludes Walter.

"The potential benefits are huge. HPC centres will obtain new revenue streams, cloud service providers will be able to develop new markets, and large enterprises will benefit from hybrid HPC."

Philippe Bricard, HEROES project coordinator

PROJECT ID CARD

Full name: Hybrid Eco Responsible Optimized European Solution
Project dates: 1 March 2021 – 28 February 2023
Coordinated by: UCit in France
Funded under: Horizon 2020-LEIT-ICT
CORDIS factsheet: cordis.europa.eu/project/id/956874
Project website: heroes-project.eu
Total budget: EUR 890 375
EU contribution: EUR 328 346

HEROES

HPC marketplaces for more efficient industrial products

HEROES promises to deliver the benefits of high performance computing to energy and manufacturing industries. The project's future framework will enable small and medium-sized enterprises, large businesses, universities and research centres to create more energy-efficient products.

Outstanding HPC technology is at our doors. Yet, its complexity has so far made it very difficult for those in need of all this computing power, such as industry players and scientists, to exploit its full potential.

With HEROES, project coordinator Philippe Bricard and other partners want to remove obstacles standing in the way of these users. They have been working on a software solution that can be used to submit complex simulation and machine learning workflows to HPC data centres and cloud infrastructures.

"HEROES is a framework to create what we call marketplaces," explains Bricard, CEO and founder of HPC solution provider UCit. "We are working on a decision module able to select the most appropriate platform for the users' specific artificial intelligence or machine learning workflow, based on the strategies they define. Users just need to log in, select an application workflow and define their placement strategy."

These criteria include, for example, best performance, best price to performance ratio, lowest cost, best eco-responsibility and best energy to performance ratio.

The project team will specifically focus on the workflow requirements of the renewable energy and manufacturing industries, to help them develop more energy-efficient products (such as energy-efficient vehicles).

Ultimately, the software and its marketplaces could be used by large companies to build their own HPC infrastructure, by service providers to build multicloud or multicluster HPC platforms, or by universities and research labs looking for resources to distribute their application codes and workflows.

"The potential benefits of HEROES are huge. We can apply the platform to different contexts and requirements of different types of users. HPC centres will obtain new revenue streams, cloud service providers will be able to develop new markets, and large enterprises will benefit from hybrid HPC," says Bricard.

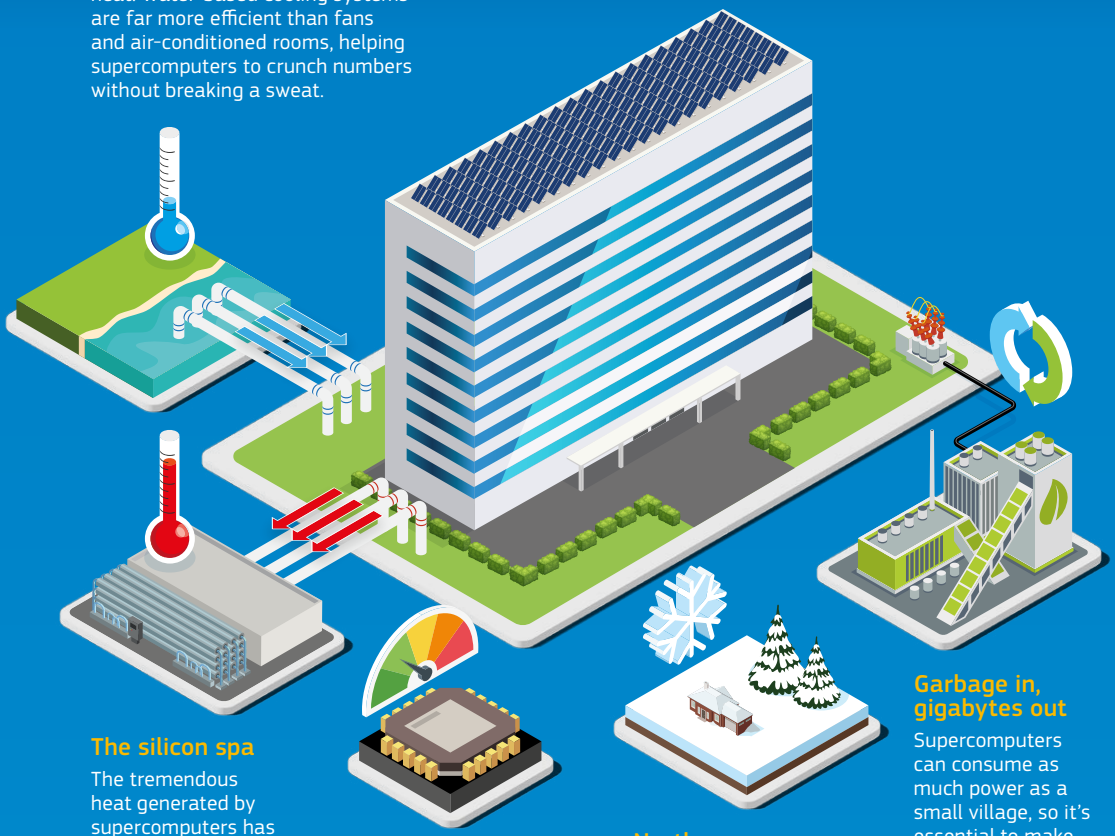
"Our goal when the project ends is to proceed to direct sales or licensing to help clients building their own HPC marketplaces. We also see a real opportunity in designing and operating a service that would allow us to bring EuroHPC resources to the European research community or to SMEs."

Lean, green, numbers machine

Power isn't everything. In line with the EU's ambitious plans to achieve carbon neutrality by 2050, the EuroHPC JU has been instrumental in supporting the development of supercomputers that are big on power and low on environmental impact.

A series of tubes

Supercomputers generate a lot of heat. Water-based cooling systems are far more efficient than fans and air-conditioned rooms, helping supercomputers to crunch numbers without breaking a sweat.



The silicon spa

The tremendous heat generated by supercomputers has to go somewhere. Instead of venting it into the environment, LUMI in Finland uses water warmed up by the supercomputer to heat the surrounding buildings.

Low-energy chips

The EuroHPC JU is also helping to redesign supercomputers from the inside out. The energy-efficient microchips being developed by EPI SGA2 will help reduce power consumption even further.

Northern exposure

Another way to help supercomputers keep their cool is to build them in suitable climates. Ambient temperatures in Kajaani rarely exceed 16° C, the perfect place for Finland's LUMI.

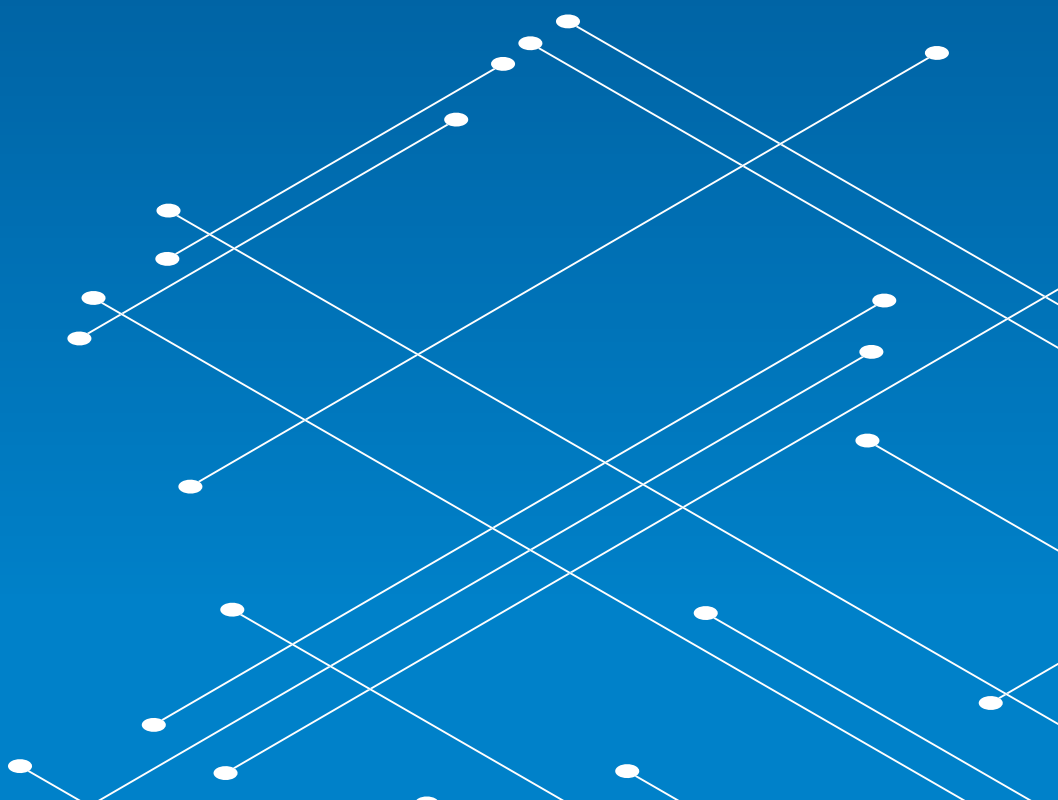
Garbage in, gigabytes out

Supercomputers can consume as much power as a small village, so it's essential to make sure that electricity is sustainably sourced. In Bissen, Luxembourg, a local power station burns wood waste to keep MeluXina's lights on.

Two of the EuroHPC systems have already reached top 10 spots on Top500's list of green supercomputers.

Source data: EuroHPC JU and top500.org

APPLIED COMPUTING



"We plan to start with the identification of novel broad-spectrum antiviral drugs, evaluating trillions of molecules against tens of viral functional targets."

Andrea Beccari, senior director and head of EXSCALATE at Dompé farmaceutici

PROJECT ID CARD

Full name: LIgand Generator and portable drug discovery platform AT Exascale

Project dates: 1 January 2021 – 31 December 2023

Coordinated by: Dompé farmaceutici in Italy

Funded under: Horizon 2020-LEIT-ICT

CORDIS factsheet: cordis.europa.eu/project/id/956137

Project website: ligateproject.eu

Total budget: EUR 5 938 656

EU contribution: EUR 2 612 060

LIGATE

Fast-tracked drug discovery tackles unmet medical needs

LIGATE promises a revolutionary exascale computing-based drug discovery process able to identify effective drugs in a matter of days instead of years.

It can take more than 13 years for a new drug to progress from the early discovery of compounds to clinical trials and regulatory approval. And that's not even considering the very low success rate of this process: less than 10 % of clinical trials are successful, only 1 out of 5000 drugs makes it to market, and the marketed drugs are often only suitable for a portion of patients.

This inefficiency and low success rate contribute to the extremely high cost of developing new drugs. The LIGATE project team banks on a new generation of artificial intelligence, modelling and simulations platforms to solve these problems.

"We are leveraging the unprecedented availability of computational resources and advanced machine algorithms," says Andrea Beccari, senior director and head of EXSCALATE at biopharmaceutical company Dompé farmaceutici. "Our objective is to build a fully integrated drug design HPC platform, not for coding experts, but rather for the scientists who need it to test out their theories much faster."

The consortium members promise nothing short of "the highest speed and the highest accuracy" to users of their platform. In case of urgent computing needs – a situation researchers recently went through with COVID-19 – the system will even run in silico drug discovery campaigns in less than a day.

Unlike current systems, LIGATE is able to consider all the complexity and systemic perturbations a disease produces. Another key advantage of such a platform is the reduced need for animal testing.

"We plan to start with the identification of novel broad-spectrum antiviral drugs, evaluating trillions of molecules against tens of viral functional targets (helicase, polymerase, protease, etc.)," Beccari explains. "The best compounds will then be experimentally validated."

While full project results won't be available before the end of 2023, breakthroughs from both ANTAREX – which identified a potent inhibitor for the Zika virus – and EXSCALATE4CoV – which validated the osteoporosis drug raloxifene as an effective treatment for inflammatory processes induced by COVID-19 – certainly promise great things to come.

"With MICROCARD, we will be able to simulate sizeable tissue samples – hopefully even whole hearts – with realistic cell geometries."

Mark Potse, MICROCARD project coordinator

PROJECT ID CARD

Full name: Numerical modeling of cardiac electrophysiology at the cellular scale

Project dates: 1 April 2021 – 30 September 2024

Coordinated by: Bordeaux University in France

Funded under: Horizon 2020-LEIT-ICT

CORDIS factsheet: cordis.europa.eu/project/id/955495

Project website: microcard.eu

Total budget: EUR 5 858 546

EU contribution: EUR 2 777 053

MICROCARD

Modelling every cell of an arrhythmic heart

By bringing computer scientists, mathematicians and biomedical engineers together, the MICROCARD project hopes to better help patients with heart rhythm disorder. Their new software is expected to solve many problems inherent to current numerical models.

Almost everyone has experienced the sensation of their heart racing, or a fluttering in their chest. For most this will be both temporary and harmless, but for others it's evidence of a malfunction in the electrical impulses regulating heartbeat, a life-threatening condition called cardiac arrhythmia.

To better understand and treat this condition, cardiologists have been using numerical electrophysiology models that divide the heart into elements, each covering a few hundred cells. But such an approach has shown its limits.

"These models are basically assuming that all cells in each group are doing more or less the same thing. This is a reasonable assumption when looking at a healthy heart, where the electric coupling between these cells is strong, but it doesn't hold for structurally damaged hearts," says Mark Potse, research professor in cardiac modelling at IHU Liryc in France and MICROCARD project coordinator.

In unhealthy hearts with infarction scars or various cardiomyopathies, the electrical activation can end up running in circles, leading the heart to possible fatal arrhythmia. As the individual behaviour of each cell is crucial in these events, Potse and his team working under the MICROCARD project have been aiming to represent each one of them in HPC-powered simulations.

"There have been models of individual cells before, but they were highly simplified. With MICROCARD, we will be able to simulate sizeable tissue samples – hopefully even whole hearts – with realistic cell geometries. Of course, this requires much more powerful computers along with the expertise to use these machines well," Potse explains. So far, the project has created various building blocks of the new platform.

With numerical models being used every day by dozens of research groups across the world, MICROCARD will likely be adopted by various groups to investigate the behaviour of damaged tissue and complex heart structures such as connections between the cardiac Purkinje fibres and the muscle tissue.

"We need a new generation of CFD tools that can make the most of 1 exaflop systems and, further down the line, exascale systems."

Oriol Lehmkuhl, NextSim project coordinator

PROJECT ID CARD

Full name: CODA: Next generation of industrial aerodynamic simulation code

Project dates: 1 March 2021 – 29 February 2024

Coordinated by: Barcelona Supercomputing Center in Spain

Funded under: Horizon 2020-LEIT-ICT

CORDIS factsheet: cordis.europa.eu/project/id/956104

Project website: nextsimproject.eu

Total budget: EUR 3 978 097

EU contribution: EUR 1 884 705

NextSim

Next-generation algorithms for a more competitive aerospace sector

The NextSim project consortium feels that it is time for the aerospace industry to benefit from high performance computing power. The project's new simulation tools will speed up problem-solving during research, development and testing phases of next-generation aircraft designs.

Prototyping, wind tunnel testing campaigns and real flight tests make aerospace research and development very expensive. Replicating these tests in digital space – known as computational fluid dynamics (CFD) – has considerably reduced testing costs and time to market. But these models have trouble keeping up with increasing computing power, depriving aircraft manufacturers of much needed resources.

"We need a new generation of CFD tools that can make the most of 1 exaflop systems and, further down the line, the exascale systems which are expected to become available in less than 3 years," says Oriol Lehmkuhl, leader of the Large-scale Computational Fluid Dynamics group at the Barcelona Supercomputing Center.

With NextSim, project coordinator Lehmkuhl and his partners promise a set of new algorithms with improved convergence and accuracy. As he explains, "NextSim's research will assess and improve the fundamental algorithms used in aeronautical simulation solvers. We're aiming for less than 1 hour to complete a 3D aircraft simulation, and 1 night to provide complex 3D unsteady Turbulent Scales Resolving Simulations solutions. These will enable aircraft designers to obtain many more optimised results in less time."

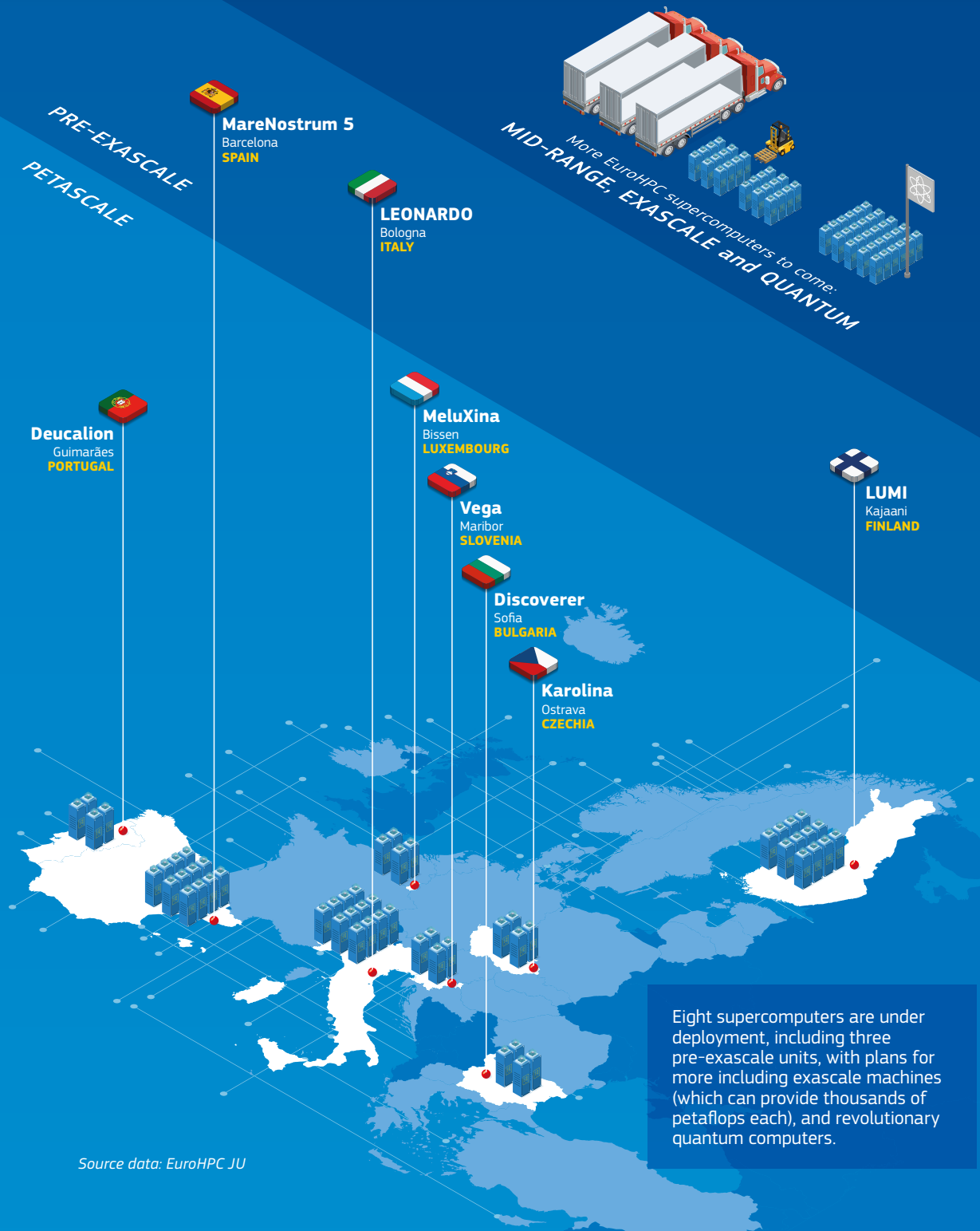
The project comes in a context of growing CFD usage, and industrial demand for larger and longer simulations. Current numerical tools provide excessively long computational times for problems of industrial relevance, and users have been faced with a lack of reliability and accuracy of these solutions in extreme flight conditions.

As Lehmkuhl remarks, "these weaknesses prevent the full industrial deployment of virtual tools for design and certification. This applies not only to the aeronautical industry, but also to automotive, wind energy, propulsion, additive manufacturing and many other sectors."

One of NextSim's key endeavours will be the demonstration of its methodologies for market-relevant problems defined by project partner Airbus. Although it will be focusing on aeronautical issues like emissions reduction, safety, noise and performance, the project's research can be applied to any sector relying on numerical discretisation and integration of partial differential equations for its designs.

Putting EuroHPC JU on the map

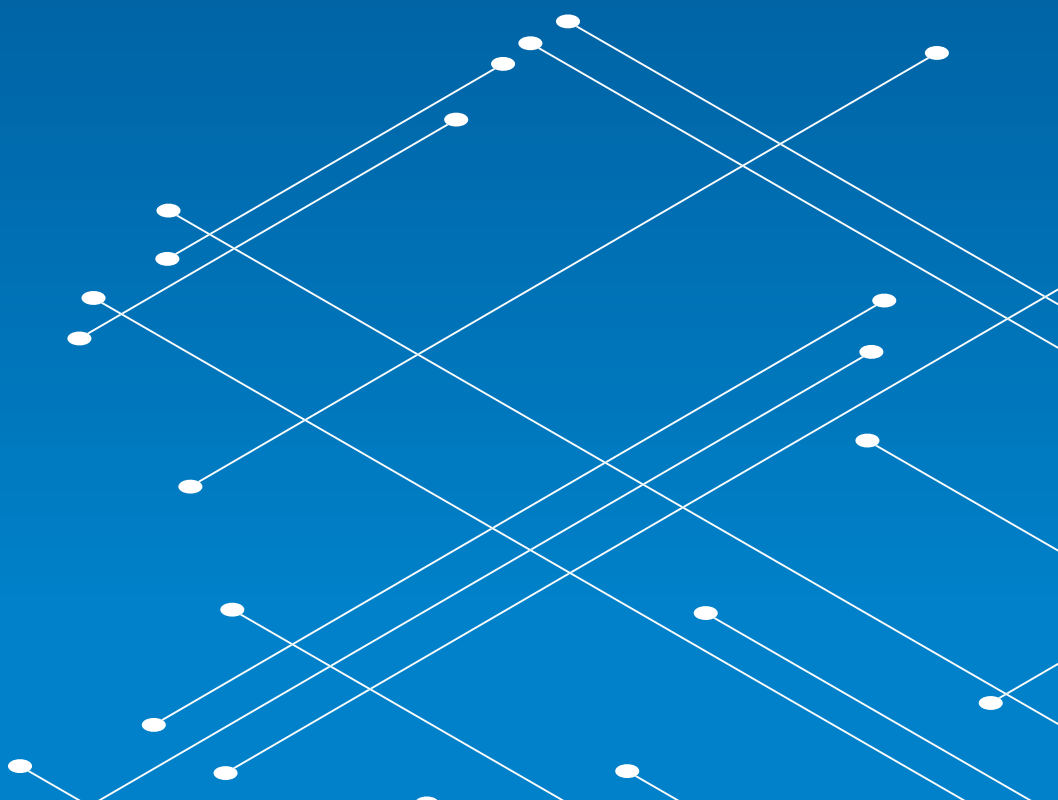
The EuroHPC JU includes 31 countries working together to build Europe's supercomputing resources.



Eight supercomputers are under deployment, including three pre-exascale units, with plans for more including exascale machines (which can provide thousands of petaflops each), and revolutionary quantum computers.

Source data: EuroHPC JU

21st CENTURY SKILLS



"By working together on topics of common interest, NCCs are creating a thriving HPC ecosystem, with the two-way exchange between the European and national levels."

Bastian Koller, EuroCC project coordinator

PROJECT ID CARD

Full name: National Competence Centres in the framework of EuroHPC
Project dates: 1 September 2020 – 31 August 2022
Coordinated by: University of Stuttgart in Germany
Funded under: Horizon 2020-Science with and for Society
CORDIS factsheet: cordis.europa.eu/project/id/951732
Project website: eurocc-access.eu
Total budget: EUR 56 329 834
EU contribution: EUR 27 936 679

EuroCC

National one-stop shops for HPC competencies

EuroCC's National Competence Centres act as hubs to promote and facilitate HPC and related technologies across a range of industries, increasing access to opportunities and offering tailored solutions for this fast-evolving field.

While previous European initiatives have been launched to encourage the adoption of HPC and associated technologies, many prioritise a national focus, resulting in a landscape of varying competence.

"To truly develop a globally competitive European HPC skills base – with a clear impact on society, industry and scientific excellence – European countries should be at comparable levels of competence," says Bastian Koller, project coordinator of the EU-funded EuroCC project.

EuroCC has set up 33 National Competence Centres (NCCs), the first initiative within EuroHPC to bring so many countries together. Each NCC is supported by its Member State, including 50 % cost-sharing, and is guided by the objectives of consolidation, integration and exchange.

By first identifying their available competencies, individual countries can maximise synergies to build national competence portfolios. To ensure these benefit the whole network, European-level activities are coordinated through sister project CASTIEL. The NCC network also cooperates with external bodies such as Centres of Excellence, the ETP4HPC and PRACE.

As some countries have already benefited from significant national HPC investment, one of the biggest challenges for EuroCC has been standardising competence levels across the network. In response, an NCC twinning and mentoring programme, financed by CASTIEL, has been established to share knowledge and skills.

But as Koller explains, "the disparities actually help by highlighting specific areas for impactful collaboration and guiding the network's collective trajectory and vision."

The disparities have also generated a catalogue of various tried-and-tested solutions to problems encountered across the network. EuroCC is currently focused on training delivery, continued interaction with industry, competence mapping and communications. Crucially, it is also exploring new fields, such as quantum computing and artificial intelligence (AI) to identify future NCC priority topics.

"By working together on topics of common interest, NCCs are creating a thriving HPC ecosystem, with the two-way exchange between the European and national levels that raises everyone's game," concludes Koller.

"HPC can now help SMEs solve problems that they simply couldn't before, often igniting new business models."

Guy Lonsdale, FF4EuroHPC project team member

PROJECT ID CARD

Full name: FF4EuroHPC: HPC INNOVATION FOR EUROPEAN SMES
Project dates: 1 September 2020 – 31 August 2023
Coordinated by: University of Stuttgart in Germany
Funded under: Horizon 2020-LEIT-ICT
CORDIS factsheet: cordis.europa.eu/project/id/951745
Project website: ff4eurohpc.eu
Total budget: EUR 9 998 475
EU contribution: EUR 9 998 475

FF4EuroHPC

Access to cutting-edge technology boosts business

By supporting experiments that connect businesses with HPC resources, FF4EuroHPC's success stories are inspiring small and medium-sized enterprises (SMEs) to embrace cutting-edge technologies.

SMEs account for 99% of all European businesses, forming the backbone of Europe's economy. But to grasp the opportunities offered by the pace and scope of digitalisation, many need better access to computing resources.

The EU-supported FF4EuroHPC helps SMEs access funds and expertise to both increase their own commercial potential and boost European innovation and competitiveness.

With a background in simulation software, Guy Lonsdale from the project team has watched HPC use evolve from computer-aided design to cutting-edge data analytics and machine learning (ML).

"The field is now coming of age as technological advances converge with business needs," says Lonsdale. "HPC can now help SMEs solve problems that they simply couldn't before, often igniting new business models."

FF4EuroHPC follows two previous EU-supported projects, Fortissimo and Fortissimo 2. Both reached out to SMEs through open calls to fund 18-month experiments demonstrating the business benefits of HPC. Project partners supported the consortia with access to computing resources through a cloud-based infrastructure.

The result was 79 success stories showcasing a wide range of innovations, from simulations for light-aircraft aerodynamics to assessments of pre-existing drug compounds for potential treatments beyond current prescriptions.

Guided by the same approach, FF4EuroHPC has undertaken two funding calls for 15-month long experiments.

The first call resulted in EUR 3 million being released for 16 proposals, involving 53 organisations, 27 of which are SMEs. The second call released almost EUR 5 million to 26 funded proposals, involving 79 organisations, including 47 SMEs.

As before, FF4EuroHPC's selections represent a wide spectrum of applications.

"There are always surprises with these calls, such as using HPC and ML techniques, combined with sensors and an internet of things platform, for next-generation hen farming," explains Lonsdale.

To help build a fast-evolving and diverse HPC ecosystem, FF4EuroHPC encourages knowledge exchange between experiments, such as through workshops. "Our new experiments are on track to deliver more pioneering business-oriented success stories to promote further HPC take-up by European SMEs," concludes Lonsdale.

"Students will graduate from the programme equipped with the skills and confidence they need to drive Europe's digital transformation."

Pascal Bouvry, EUMaster4HPC project coordinator

PROJECT ID CARD

Full name: European Master for High Performance Computing (EUMaster4HPC)

Project dates: 1 January 2022 – 31 December 2025

Coordinated by: University of Luxembourg in the Grand-Duchy of Luxembourg

Funded under: Horizon 2020-Science with and for Society

CORDIS factsheet: cordis.europa.eu/project/id/101051997 (this page will be available soon on the CORDIS website)

Project website: eumaster4hpc.uni.lu

Total budget: EUR 7 000 000

EU contribution: EUR 7 000 000

EUMaster4HPC

Mastering the science of high performance computing

A new Master's programme aims to provide Europe with the skilled workforce it needs to leverage the opportunities presented by high performance computing.

HPC is a key component in Europe's digital transformation. "HPC is a rapidly growing field of research and development that has a strong potential for driving economic growth," says Pascal Bouvry, a professor at the University of Luxembourg.

However, leveraging HPC's full potential first requires the availability of a highly skilled workforce. "Without professionals educated in HPC and such related fields as data science and artificial intelligence, Europe risks missing this unique opportunity to advance its Digital Single Market," adds Bouvry.

While basic computer science and programming languages are included in many university curricula, these skills fail to meet the demands of the rapidly developing HPC technology ecosystem. That's why, with the support of the EU-funded EUMaster4HPC project, the University of Luxembourg is coordinating an effort to develop a European Master of Science (MSc) in HPC.

"Our goal is to gather all the expertise and knowledge that currently exist across European universities, research centres, industry, businesses, public administrations and SMEs and consolidate this into a single, pan-European graduate-level programme," explains Bouvry, who serves as project coordinator.

The 2-year Master's programme will start with a focus on HPC fundamentals before transitioning to specialisations during the second year of study. The programme will also include a mentorship initiative and an internship at a European HPC centre, research laboratory or company. To complete the degree, students will be required to write a thesis and defend it in front of a jury of experts.

"Students will graduate from the programme equipped with the skills and confidence they need to lead the adoption of HPC technologies and drive Europe's digital transformation," adds Bouvry.

The new MSc programme will be rolled out and piloted across several leading European universities. While some pilots will use existing programmes and courses in HPC, others will use new material prepared by the project. Based on these pilots, the project plans to create a coordinated, systemic approach to HPC training that they will make available for use by other universities.

Glossary

Accelerator refers to a hardware device or a software program with a main function of enhancing the overall performance of the computer. Various types of accelerators exist to enhance different aspects of a computer's function.

Algorithms are a finite sequence of well-defined instructions, typically used to solve a class of specific problems or to perform a computation. Algorithms are used in mathematics and computer science for performing calculations and data processing.

Application codes are software that address specific tasks for users, e.g. to solve a numerical problem.

Artificial intelligence (AI) is a field of computer science that endows systems with the capability to analyse their environment and take decisions with a degree of autonomy to achieve set goals. AI systems are used to perform complex tasks in a way that is similar to how humans solve problems.

Big data refers to large amounts of data that cannot be processed by traditional applications. Data can either be created by people or generated by machines, such as satellite imagery, digital pictures and videos, GPS signals, and more.

Chip means an electronic device comprising various functional elements on a single piece of semiconductor material, typically taking the form of memory, logic, processor and analogue devices, also referred to as an integrated circuit.

Cloud computing is a technology which allows internet users to store or use software on a server run over the internet. The stored information can then be accessed on any device from any location as long as internet access is available.

Exascale supercomputers are capable of executing more than 10^{18} (one billion billion) operations per second. By comparison, a laptop achieves around 1 000 billion operations per second.

HPC ecosystem refers to all the elements of the high performance computing value chain: the communities and stakeholders, but also the systems and the technologies, software and hardware elements which underpin these systems: from processors, accelerators, software, algorithms and applications to skills and expertise.

Hybrid computing blends the best of quantum and classical high performance computing technologies to perform even greater numbers of operations in parallel.

Machine learning is a type of artificial intelligence that allows software applications to become more accurate without being explicitly programmed to do so.

Petascale supercomputers are capable of executing more than 10^{15} (one million billion) operations per second.

Pre-exascale supercomputers are capable of executing more than 10^{17} (100 million billion) operations per second.

Processors are the electronic circuitry that carry out the instructions that drive a computer. Processors are the building block of supercomputers.

Quantum computing uses quantum technologies to compute millions of possibilities in parallel, instead of one at a time as standard computers do.

Quantum simulators are quantum computers that manipulate quantum bits (qubits) as an ensemble rather than addressing individual qubits.

Software is a collection of instructions that tell a computer how to work. This is in contrast to hardware, from which the system is built and actually performs the work.

SMEs are small and medium-sized enterprises.

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