



How to build a truly European
next generation HPC infrastructure?

Collaboration
Smart Specialisation
Sustainable Future



The European Union is investing heavily in high performance computing (HPC) to keep Europe globally competitive and to build a sustainable platform for advancing research, innovation and industrial growth.

EuroHPC is a concrete initiative to fund a world-class European supercomputing infrastructure from 2018–2026 to meet the demands of European research and industry, with a jointly-funded budget of around 1,4 billion euros, this provided by the EU, participating countries and private partners.

The EuroHPC Joint Undertaking has launched a funding call for hosting at least two pre-exascale systems. There is a consortium being built, to host one pre-exascale machine and place it in the [CSC datacenter in Kajaani, Finland](#). The consortium countries are the Nordic countries Finland, Sweden, Denmark and Norway together with Belgium, the Czech Republic, Estonia, Poland and Switzerland. More countries are set to join the consortium in future.

Kajaani is located 550 kilometers north of Helsinki, and the CSC datacenter offers many competitive advantages including energy and cost efficiency, societal and geographical stability and high security standards as well as providing a perfect environment for a state-of-the-art pre-exascale installation.

EuroHPC consortium countries





Collaboration



Photo: Lauri Heikkinen/
Prime Minister's Office

“ The corner stones of the preparation for our European HPC consortium are Finnish world-class data intensive research and know-how as well as CSC’s unique service concept. Boosting our common skills development is the main driver for Finland and the potential partner countries to be part of European HPC development and co-operation. The pre-exascale supercomputer strengthens European co-operation and complements our national supercomputing environments.”

**Sanni Grahn-Laasonen,
Finland’s Minister of Education**

Shared core values

EuroHPC is ultimately about the common European added value.

The core European values of openness, trust, and transparency are reflected in the way the consortium has been assembled, and the consortium countries share a long history in promoting them. A guiding principle is, that together we build expertise and are able to achieve more. We need to collaborate and pool our HPC resources and expertise in Europe.

Excellence and standing in HPC and data management

Purchasing supercomputers alone will not ensure Europe a leading place in innovation and science without the necessary training and skills development. This consortium is shifting the paradigm of supercomputing; instead of merely providing computing resources, at the core of the consortium’s expertise is the ability to provide comprehensive supporting services e.g. skills development, expert support and data management services.

The consortium builds on a solid tradition of collaboration in HPC and data management. The consortium countries have been actively involved in European collaboration in HPC and data management for years, for example through PRACE (Partnership for Advanced Computing in Europe), where Switzerland is one of the five hosting members contributing to the computer systems and their operations. In addition, Finland currently holds the Vice Chair position of the PRACE Council.

Each of the consortium partners has a long history of providing reliable and future proof services, such as training expert support and data management. Two PRACE Training Centers are located in the consortium countries: in Finland and in the Czech Republic, bringing world-class training in HPC and scientific computing free of charge to researchers all over Europe.

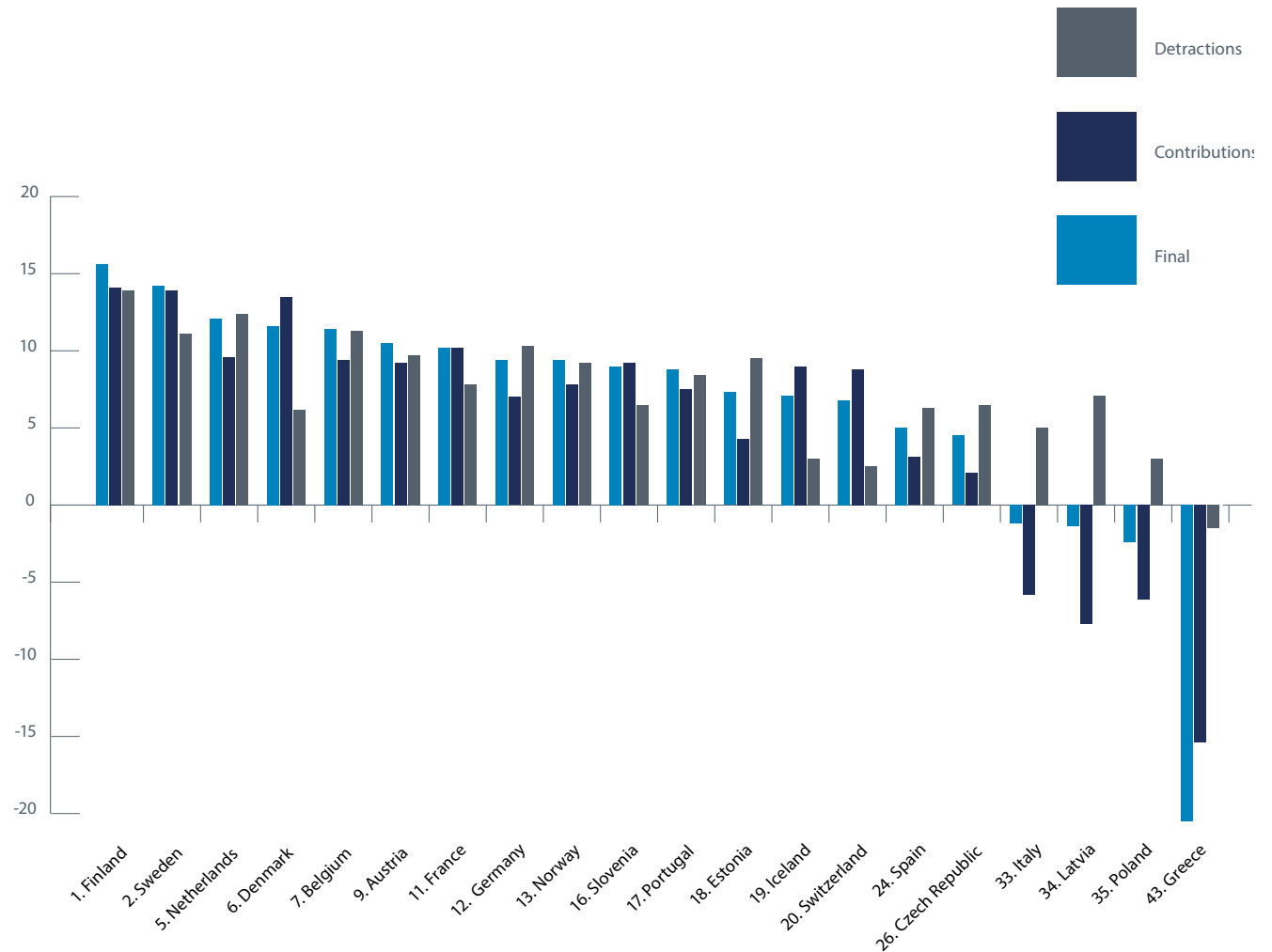
Many of the consortium countries are forerunners in founding and developing valuable European data entities, such as RDA (Research Data Alliance), EOSC (European Open Science Cloud) and EUDAT (European Data Infrastructure).

Continuity and commitment

The consortium countries cover over 30 per cent of the countries which have signed the EuroHPC declaration. The consortium countries invest significantly in R&D structures, and are consistently building up their competences. The consortium is committed to continuous development of world-class research and innovation both in and out of academia.

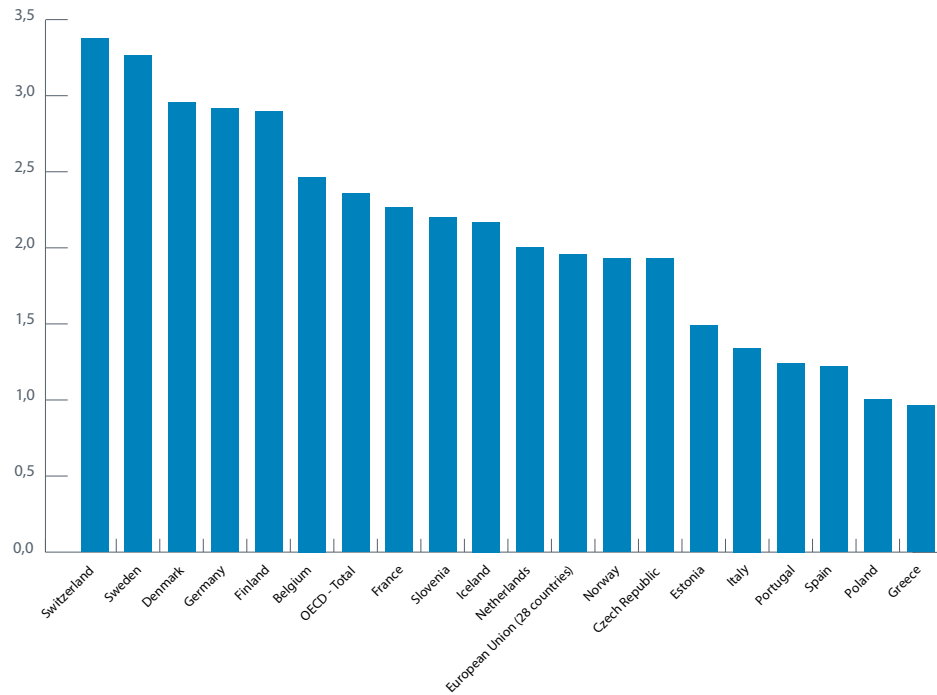
According to ITIF 2016 Finland and Sweden are world top contributors to the global innovation system

Two other consortium countries: Denmark and Belgium, are among the top ten contributors. Source of data: <https://itif.org/publications/2016/01/20/european-countries-have-positive-impact-global-innovation-itif-finds>



In EU, the average R&D expenditure was 1.96 % of the GDP in 2015

In EU28, the average R&D expenditure was 1.96 % of the GDP in 2015. This percentage was exceeded by a vast majority of the consortium countries. In 2015, Sweden had for example, the highest R&D expenditure in the EU28 (3.26%), and Finland and Denmark were among the top five countries in that group. In Switzerland the expenditure was even higher (3.37 %). Source of data: <https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm>



In QS Top Universities 2019 ranking ETH Zurich – Swiss Federal Institute of Technology ranked 7th in world's universities

In top 150 there were 18 universities from the consortium member countries.

Source of data: <https://www.topuniversities.com/university-rankings/world-university-rankings/2019>

Ranking	University	Country
7.	ETH Zurich - Swiss Federal Institute of Technology	Switzerland
22.	EPFL - Ecole Polytechnique Federale de Lausanne	Switzerland
78.	University of Zurich	Switzerland
79.	University of Copenhagen	Denmark
81.	KU Leuven	Belgium
92.	Lund University	Sweden
104.	KTH Royal Institute of Technology	Sweden
108.	University of Geneva	Switzerland
110.	University of Helsinki	Finland
112.	Technical University of Denmark	Denmark
117.	Uppsala University	Sweden
128.	Chalmers University of Technology	Sweden
135.	University of Oslo	Norway
138.	Ghent University	Belgium
139.	University of Bern	Switzerland
140.	Aalto University	Finland
141.	Aarhus University	Denmark
149.	University of Lausanne	Switzerland



Smart Specialisation



Photo: Laura Kotila,
Prime Minister's Office

“Placing Europe’s fastest supercomputer in Finland would significantly strengthen and complement Europe’s computing and data management research environment. In addition, it would serve the European industry and increase our expertise in the field. Placing the supercomputer in Finland would create the conditions for the creation of a wider datacluster. Kajaani is an excellent location for data centers due to cost-efficiency, environmental sustainability, and high information security.”

Mika Lintilä, Finland’s Minister of Economic Affairs

“As part of the Europe 2020 strategy, the European Commission adopted the 'Innovation Union' flagship initiative. It sets out a comprehensive innovation strategy to enhance Europe's capacity to deliver smart, sustainable and inclusive growth and highlights the concept of Smart Specialisation as a way to achieve these goals. The 'Digital Agenda for Europe' flagship initiative is also part of Europe 2020 and aims to deliver sustainable economic growth and social benefits from Information and Communication Technologies (ICT). The Digital Agenda for Europe initiative is therefore relevant to all regions and cities, as it focuses on a key element for the design of Smart Specialisation strategies.”

(European Commission: Guide to Research and Innovation Strategies for Smart Specialisation (RIS 3) May 2012)

Finland is one of the best locations for datacenters thanks to low operating costs and safe conditions. The total electricity cost for industries in Finland is one of the lowest in Europe, being only €55 per MWh in 2016 (EU average €114 per MWh, according to Eurostat). CSC has both knowledge and experience in covering the entire lifecycle of an HPC center from planning and construction to maintenance and usage as well as a solid track record of planning and implementing six fully equipped, functional data centers since 1989.

Since the operating costs, especially electricity, are considerably cheaper in Finland than in e.g. Southern Europe, this consortium is able to install a larger system at a lower price.

Finland is one of the pioneers in telecommunication and internet technologies and this has provided Finnish companies a strong position as developers and providers of modern cloud-based services.

Cost-efficiency

The reliability of energy supply reduces investment costs in Finland, and the transmission reliability of the national grid is above 99.999 %. Stable natural and societal conditions ensure the continuity of a reliable supply. Companies in Finland can depend on a highly reliable and cost-effective power supply to run their business with maximum efficiency.

Connectivity

Connectivity to the CSC Kajaani data center is designed to take into account the requirements of critical HPC. The datacenter provides excellent scalability, high availability, high security and flexibility.

The Finnish National Research and Education Network (Funet) offers reliable, congestion-free connectivity through the 100 Gbps national IP/MPLS backbone and 2 x 100 Gbps connections to NORDUnet and the direct 100 Gbps connection to Europe via a sea cable, which connect Funet to GÉANT and other research networks worldwide.

Kajaani is the only supercomputing site in the Nordics supporting seamless MD-VPN integration for flexible international connectivity.

Excellent connectivity is available to all major commercial cloud providers through NORDUnet global peering infrastructure (Google, Microsoft, Amazon, Akamai, Facebook, Apple etc.).

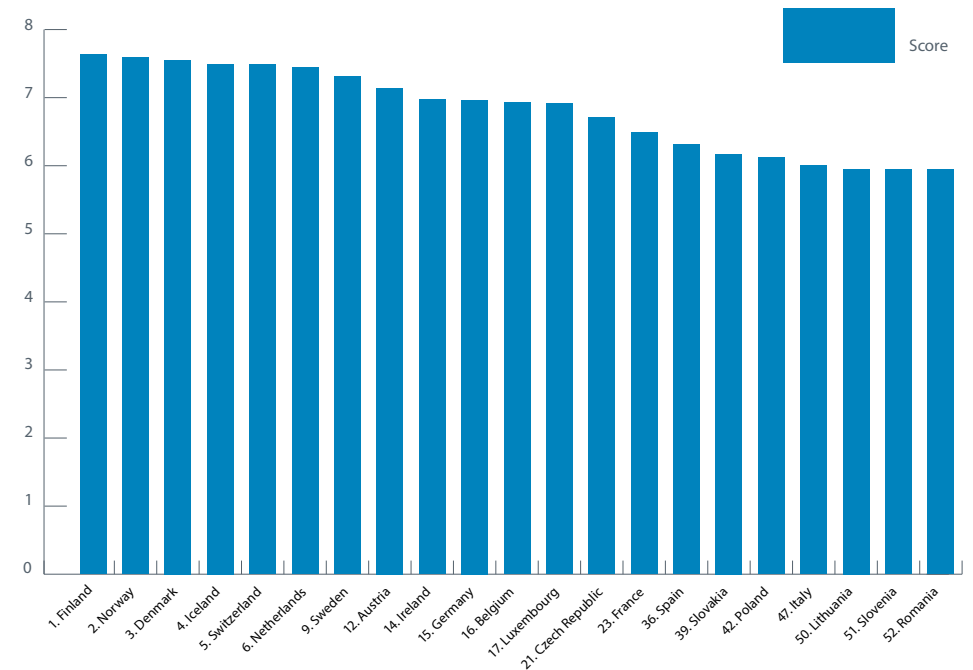
Ethernet/InfiniBand switch infrastructure provides over 100 Tbit/s of aggregate bandwidth.

Geographical, political, social, economic stability

Finland and Kajaani are low-risk areas in terms of geographical, weather, political and man-made risks. There are no risks of seismic or volcanic activities, hurricane/tidal or other form of severe weather. The Fragile States Index 2016 by Fund for Peace ranks Finland as the most stable and sustainable country in the world, and BMI Research (Fitch Group) predicts that Finland will also remain one of the most politically-stable countries globally over the next decade (2016–2025).

Ranking of Happiness 2018

Source of Data: <http://worldhappinessreport/ed/2018/>



Credit ratings in 2018

Source of Data: Fitch Ratings

AAA: Highest credit quality
 AA: Very high credit quality
 A: High credit quality
 BBB: Good credit quality
 BB: Speculative
 B: Highly speculative
 CCC: Substantial credit risk
 CC: Very high levels of credit risk

Denmark	AAA
Norway	AAA
Sweden	AAA
Switzerland	AAA
Finland	AA+
Belgium	AA-
Estonia	AA-
Poland	A-
Spain	A-
Greece	BB-
Italy	BBB
Portugal	BBB

Safety and security

The Data Center Risk Index 2016 ranked Finland as the safest location for datacenters in the EU and the fourth safest in the world. Also, other possible consortium parties are ranked as low risk countries.

Finland has a regulatory and legislative environment that respects online privacy and a flourishing cyber security sector capable of delivering the latest solutions to protect data from unlawful access. Finland offers one of the safest and most reliable environments in the world for storing and processing information.

Kajaani is on its way to become an Arctic data hub

The Kajaani region is growing significantly around the datacenter ecosystem, centered on the Renforsin Ranta Business Park, formerly a UPM paper mill. (<http://investinkainuu.com/data-centers-digital-business>)

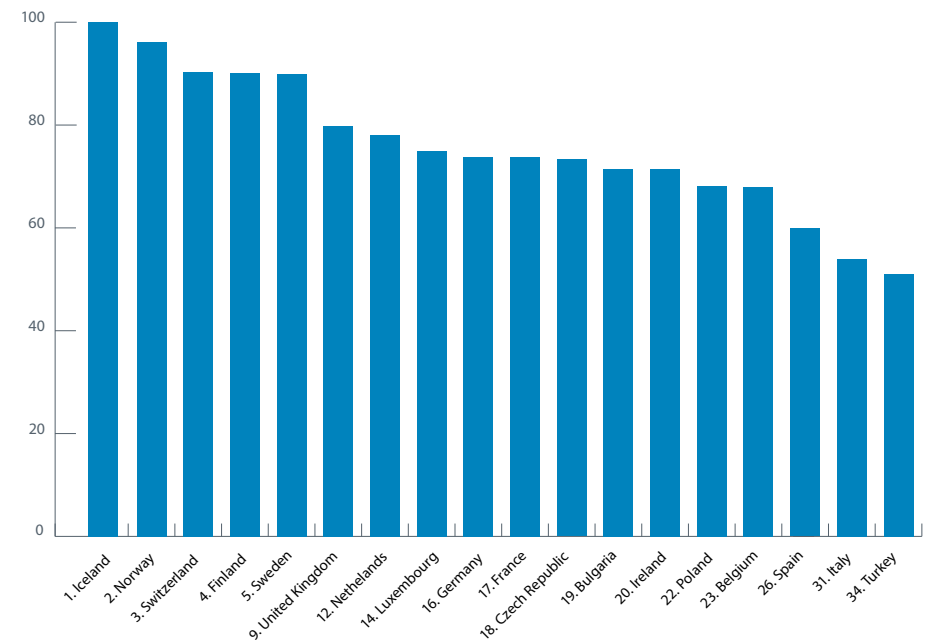
The Arctic Connect project is exploring the possibilities of building a data cable through the Northeast Passage. If and when implemented, the cable would build a digital bridge between Europe and Asia.

CSC Kajaani datacenter is surrounded by regional data-analytics and ICT expertise. The datacenter industry has become one of Kajaani's strengths alongside numerous ICT companies. Local authorities, universities, funding organisations and industry are all onboard in the ecosystem.

Datacenter Risk Index 2016

Index score (100=best)

Source of Data: <http://www.cushmanwakefield.com/en/research-and-insight/2016/data-centre-risk-index-2016>





Sustainable Future

Reducing our global carbon footprint is a critical goal. The location of the EuroHPC machines would be significant, as supercomputers consume vast amounts of electricity. The CSC datacenter in Kajaani has a negative carbon footprint.

Eco-efficiency

Global warming is causing long-lasting and potentially irreversible changes to our climate system if we do not take action now. Reducing our carbon footprint is a globally critical target. Due to Kajaani's location in Northern Finland, the datacenter benefits from free cooling provided almost all-year-round thus saving significantly on electricity.

The electricity used by CSC's Kajaani datacenter is fully renewable. There are several local hydropower plants, and abundant green power is available. Cooling is deployed efficiently resulting in PUE 1.04 (measured average in 2017 in air cooled cabinets). Waste heat is used to warm the Datacenter premises. In the future the waste heat can also be used to heat local households.

Share of renewable energy in gross final energy consumption

Source of data: European Environment Agency (EEA)

