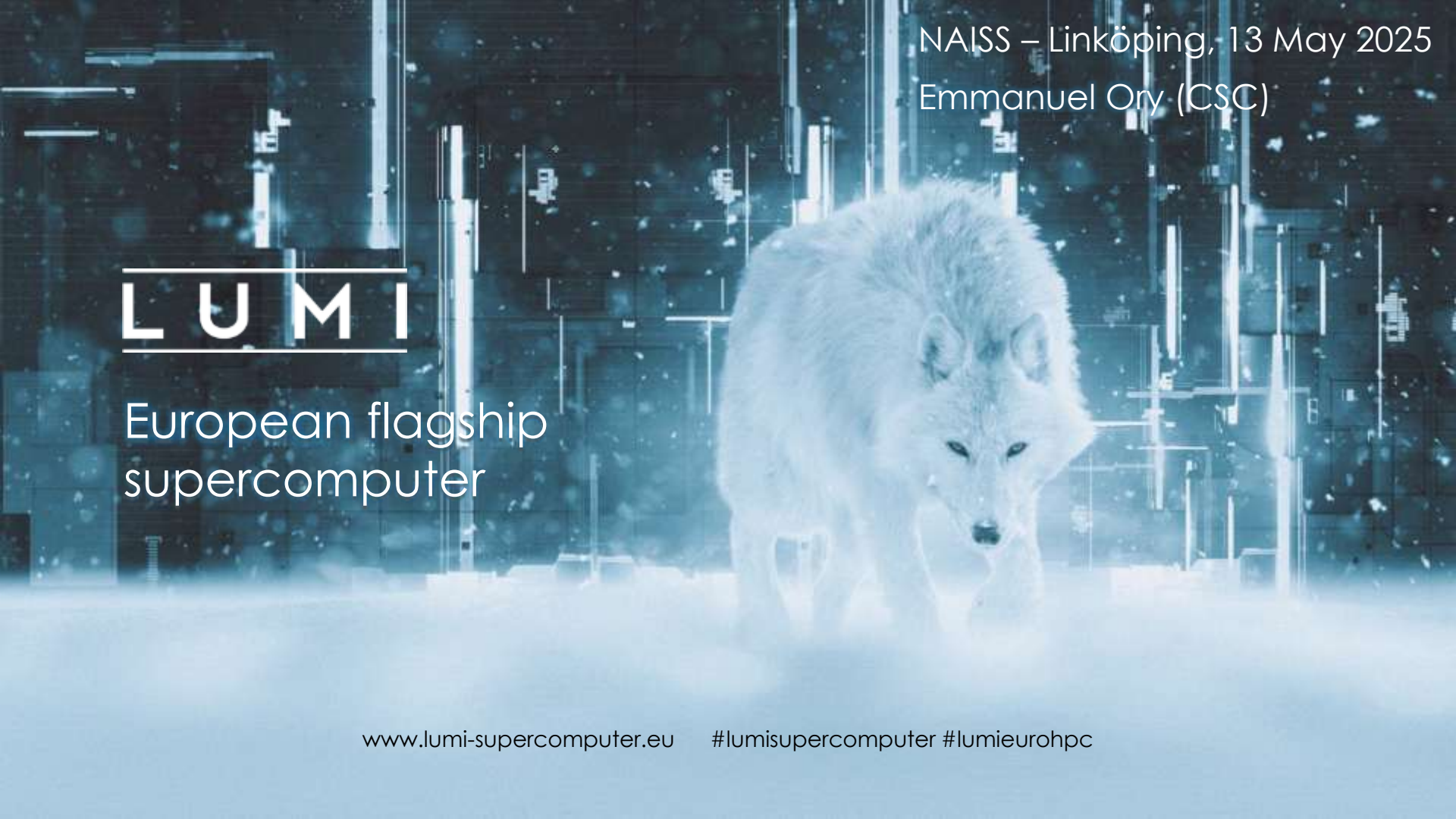



# European flagship supercomputer

NAISS – Linköping, 13 May 2025

Emmanuel Ory (CSC)

www.lumi-supercomputer.eu #lumisupercomputer #lumieurohpc

# CSC – IT Center for Science

**CSC is a company entrusted with special state assignments, owned by the state of Finland and Finnish higher education institutions.**

→ We provide high-quality ICT services to our customers

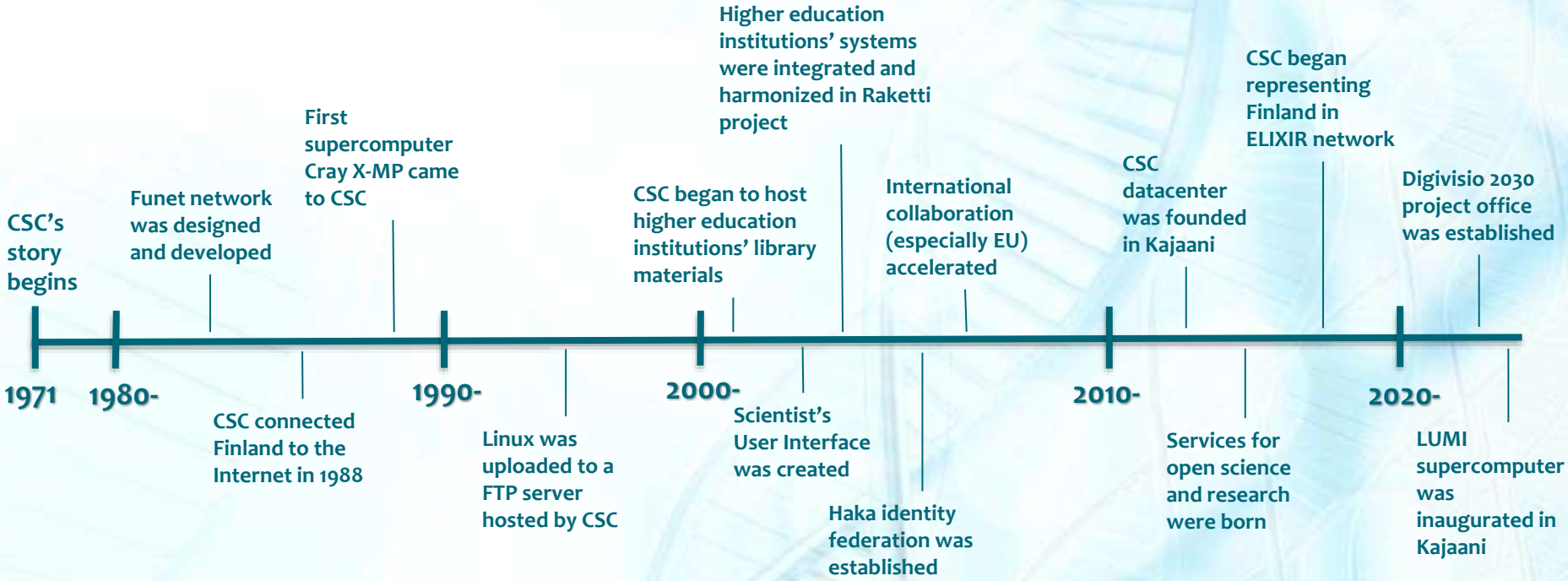
→ CSC has one of the world's most eco-efficient data center environments located in Kajaani, Finland

→ Our primary customers are the Ministry of Education and culture and organizations in the field, higher education institutions, research institutes and public administration

→ CSC is a non-profit state enterprise

We measure our success by the value we create to our owners

# CSC's history



# CSC now – We create value

## OUR CAPITAL

**Our strengths are extensive national and international cooperation and sharing of expertise**

**We enable national and pan-European research and education with advanced methods**

**High resilience of systems** – participating in emergency supply cooperation

**Low-carbon data centers** – addressing sustainability throughout the entire life cycle

**We are an attractive employer** with multicultural and international work community

**We are a non-profit company entrusted with special state assignment** – transparency of financial management and operations

## OUR PURPOSE

Together we build world-class environments for research, learning and innovation

## OUR SUSTAINABLE DEVELOPMENT GOALS


## WE CREATE VALUE FOR OUR OWNERS, CUSTOMERS AND SOCIETY

**The impact of research is strengthened,** for example, by employing solutions for data-intensive computing, sensitive data management, and digital twins.

**A smoother daily life for our customers** through digital solutions, data analytics, data hubs, and digital preservation.

**We promote service and data portability and interoperability** through our expertise, services and international networks.

# CSC's future – where are we heading?

## Our vision

- Together we build world-class environments for research, learning and innovation.
- Our vision for 2030 aims at a better future for all of us, based on digitalization and sustainable development.

## Our strategic goals

→ We provide the most impact generating HPC and data ecosystem in the world

→ We are a pacesetter for responsible adoption of artificial intelligence

→ We bridge silos to enhance customer success

EuroHPC Joint Undertaking

LUMI

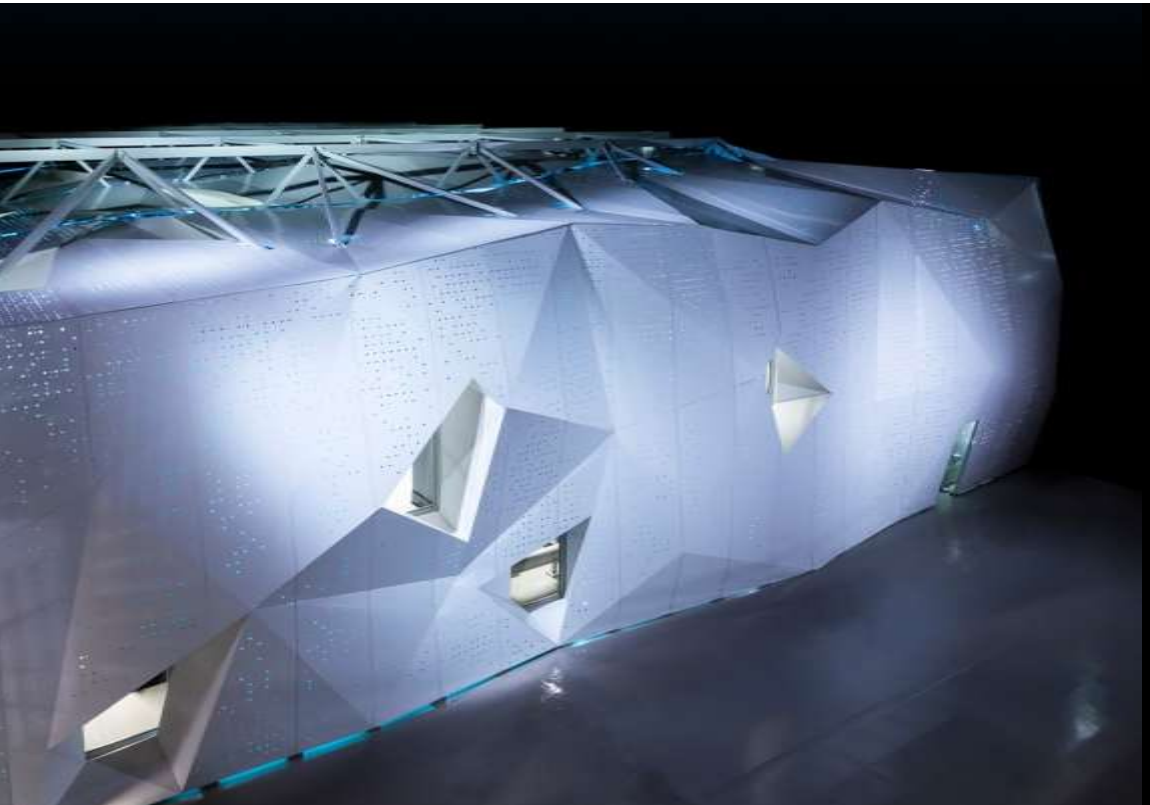
The EuroHPC Joint Undertaking pools EU and national resources to make Europe a world leader in supercomputing.

EuroHPC JU aims to:

- develop, deploy, extend and maintain in the EU a world-leading federated, secure and hyper-connected supercomputing, quantum computing, service and data infrastructure ecosystem
- widen the use the supercomputing infrastructure to a large number of public and private users and support the development of key HPC skills for European science and industry
- develop and operate AI Factories located around EuroHPC supercomputing facilities to support the growth of a highly competitive and innovative AI ecosystem in Europe

EuroHPC
Joint Undertaking

LUMI



**LUMI supercomputer is the first co-investment ever of this scale in scientific computing.**

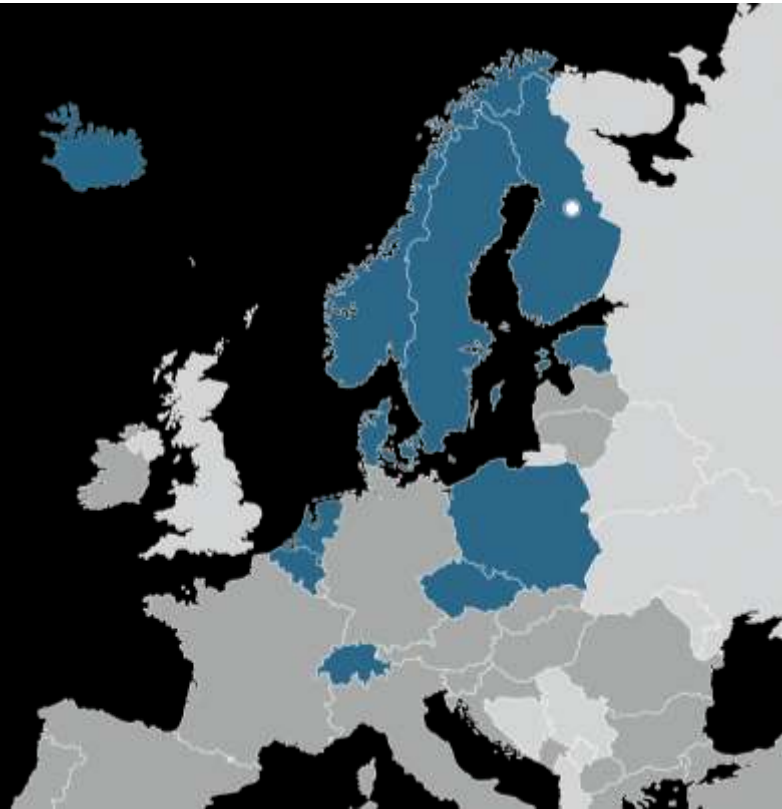
The total budget of the EuroHPC pre-exascale system in CSC's data center in Kajaani is over 202 million Euros. Half of this funding comes from the EU and the other half from the consortium countries.

EuroHPC
Joint Undertaking

LUMI

A unique collaboration between eleven LUMI consortium countries and the EU to build and operate a world-class supercomputer.

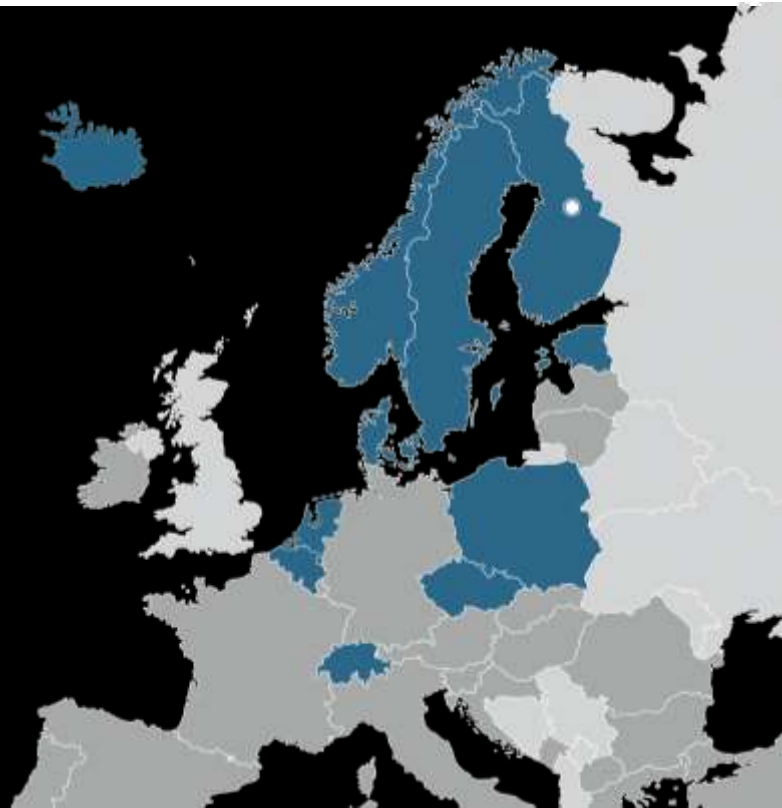
LUMI research infrastructure provides a high-quality, cost-efficient and environmentally sustainable HPC ecosystem based on true European collaboration.



The consortium continues a solid tradition of collaboration in HPC training and education, user support and data management services.

The resources of LUMI will be allocated per the investments. The share of the EuroHPC JU (50%) will be allocated by a peer-review process and available for all European researchers.

www.lumi-supercomputer.eu/get-started/



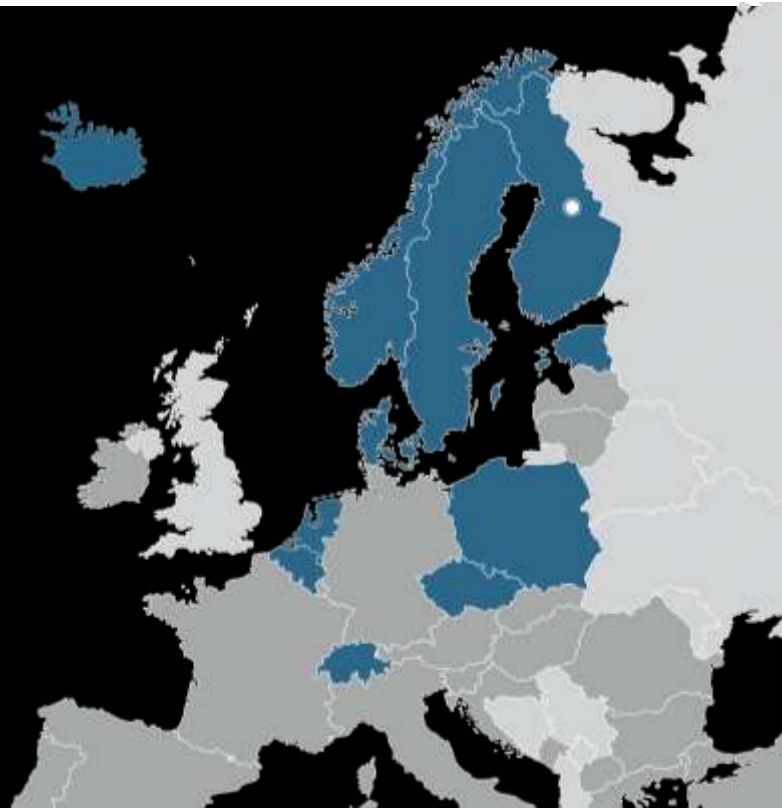
EuroHPC
Joint Undertaking

LUMI

LUMI supercomputer is hosted by the LUMI consortium. LUMI is located in CSC's data center in Kajaani, Finland.

CSC – IT Center for Science is a Finnish center of expertise in information technology owned by the Finnish state and higher education institutions.

CSC provides internationally high-quality ICT expert services for higher education institutions, research institutes, culture, public administration and enterprises.



# LUMI is an HPE Cray EX supercomputer

LUMI

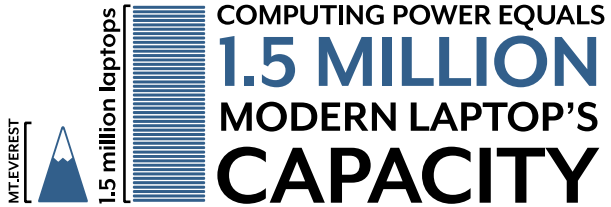
# LUMI is one of the fastest supercomputers in the world

LUMI

SUSTAINED PERFORMANCE

## 380 PETAFLOP/S

= performs 380 x $10^{15}$ calculations per second

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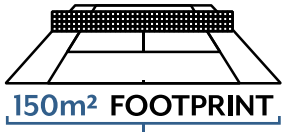




High-performance computing | AI | Data analytics

# Modern architecture

**LUMI-C:**
x86 Partition

Supplementary CPU partition:
over 262,000
AMD EPYC CPU cores.

**LUMI-K:**
Microservice platform

**LUMI-O:**
Object Storage Service

30 PB
encrypted object storage (Ceph) for storing, sharing and staging data.

**LUMI-Q:**
Quantum Computing

**High-speed interconnect**

Possibility for combining different resources within a single run. HPE Slingshot technology.

**LUMI-G:**
GPU Partition

Sustained performance
380
Pflop/s powered by AMD Radeon Instinct™ MI250X GPUs (a total of 11,912 GPUs).

**LUMI-D:**
Data Analytics Partition

Interactive partition with
32 TB
of memory and graphics GPUs for data analytics and visualization.

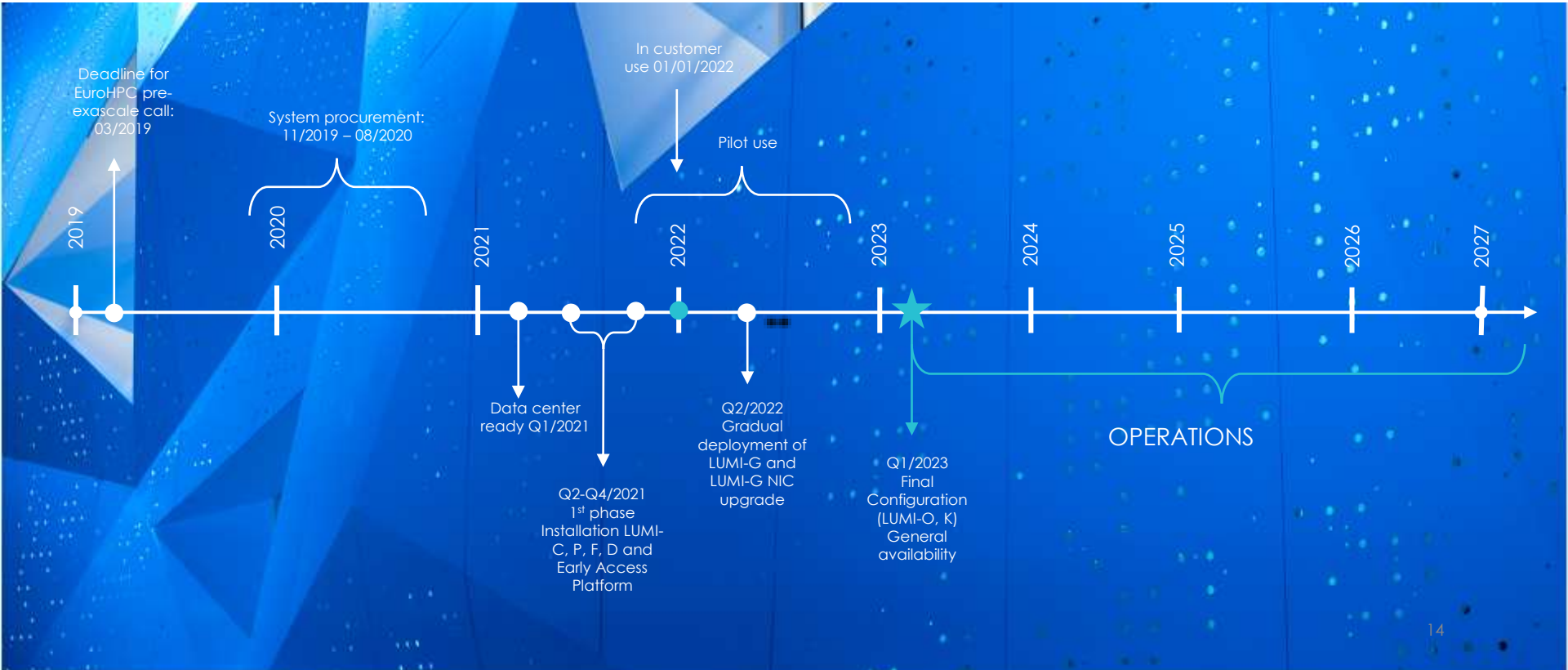
**LUMI-F:**
Accelerated Storage

10 PB
Flash-based storage layer with extreme I/O bandwidth of 2 TB/s and IOPS capability.

**LUMI-P:**
Lustre Storage

80 PB
parallel file system.

# LUMI timeline



## Up to 20%

of LUMIs capacity is reserved for European industry and SMEs

LUMI

- **To boost innovation and new data-driven business** in areas such as platform economy and AI.
- LUMI world-class computing resources **brings European RDI to the next level**
- Unparalleled computing and data management capacities for researchers in academia both and industry **opens up possibilities to address novel research questions**
- LUMI research infrastructure **positions Europe as one of the global leaders in supercomputing**

# Swedish innovation for digitalizing tabular data

Image processing & machine learning for meteorology | The Swedish Meteorological and Hydrological Institute (SMHI)

LUMI

**Project description**

- Nearly all meteorological agencies in the world, including SMHI, possesses troves of archival data of observations spanning decades in paper format. The ambition of the project is to optimize and train a sufficiently accurate **machine learning model that can handle different forms of tabular data, convert handwritten-text, and produce machine-readable files.**

**Objectives & Outcomes**

- As a result of the project, SMHI aims at digitizing numerous historical weather observations that **will help a better understanding of climate, especially of the occurrence of extreme weather events**.
- The code and the project, although young, has attracted interest both externally, from meteorology agencies abroad, and internally, from SMHI from groups dealing with paper documents in tabular format. **If successful it can accelerate the process of digitization from many such archives.**
- LUMI's huge GPU capacities benefit the project by allowing faster tuning hyperparameters of the built model.

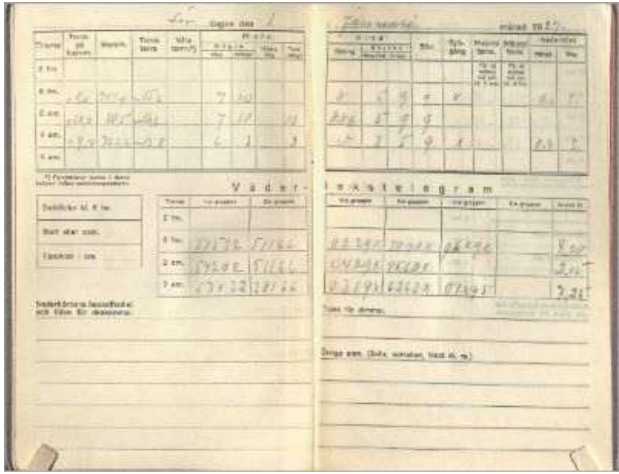


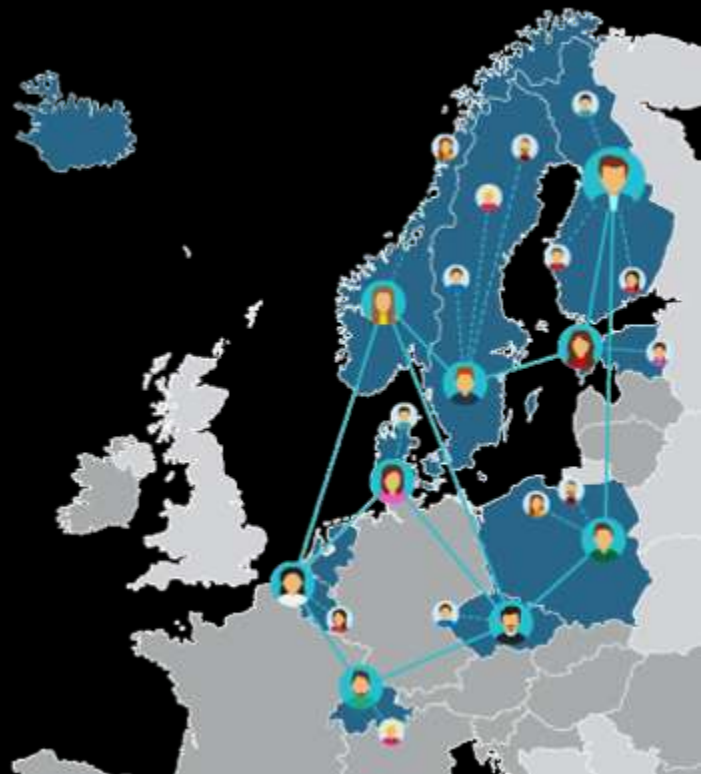
*Image: EuroCC National Competence Centre Sweden.*

Read more here.

# LUMI User Support Team

LUMI User Support and a centralized help-desk by the distributed LUMI User Support Team

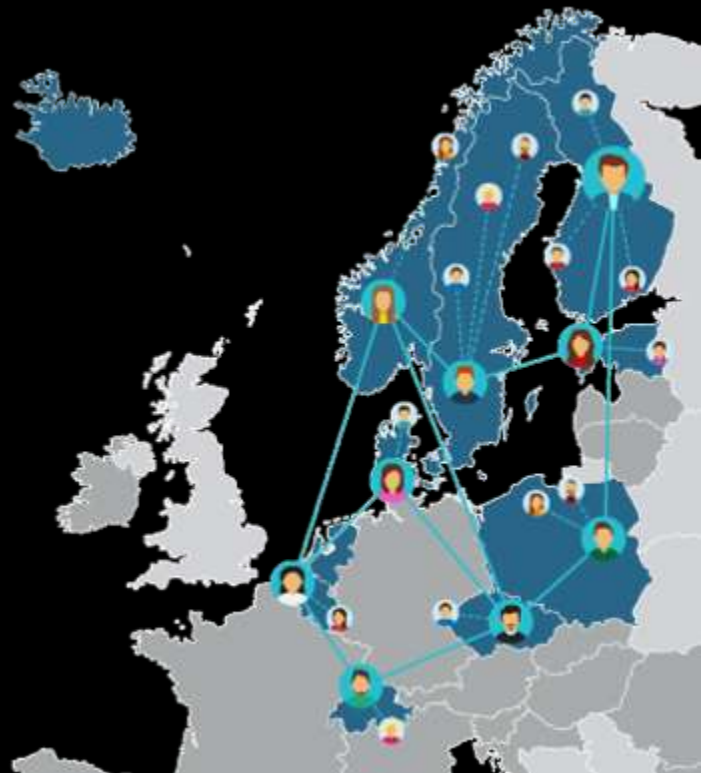
- The model is based on a network of dedicated LUMI experts: each partner provides one full-time person for the task
- User Support Team also provides end-user training, maintain the software portfolio and user documentation of the system



# LUMI User Support Team

**LUMI User Support main activities**

- Help desk from Monday to Friday 9-19 EE(S)T
- User documentation
- Computational environment
- User training
- Benchmarking, porting, optimization consultancy

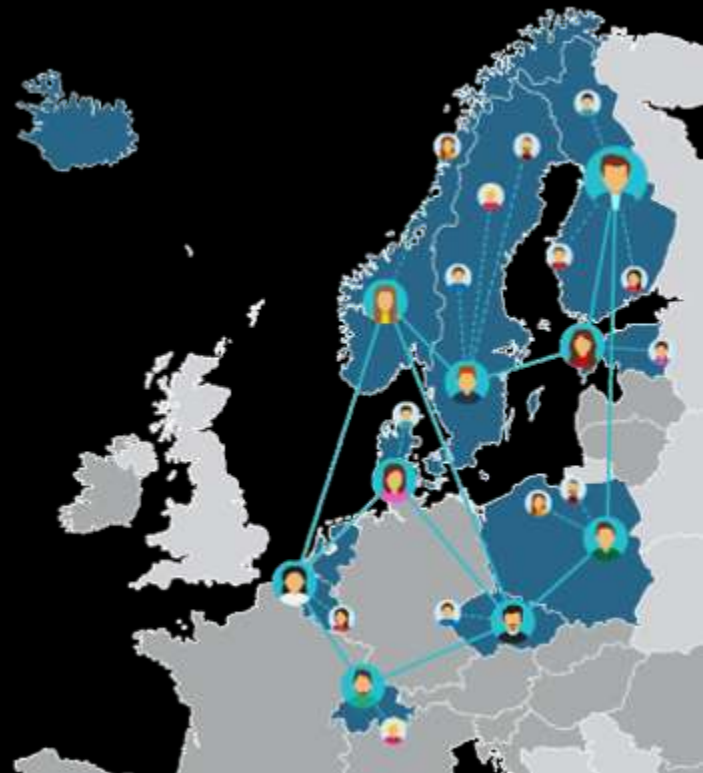


# LUMI User Support Team

**Computational environment**

The LUMI software stacks contain the software that are already installed on LUMI.

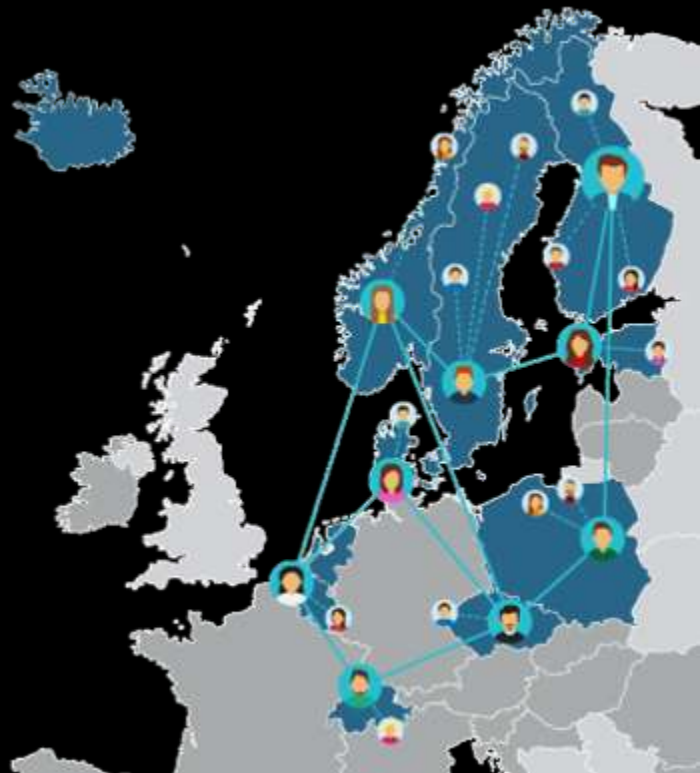
- **CrayEnv** offers the Cray Programming Environment (PE)
- **LUMI** is an extensible software stack that is mostly managed through EasyBuild.
- **Local software stack** for local organizations to manage their own software installation



# LUMI User Support Team

**User training**

- In collaboration with HPE and AMD
    - LUMI-C environment and architecture
    - LUMI-G hardware and programming environment
    - Hackathons
    - More specific trainings: EasyBuild, ML frameworks...

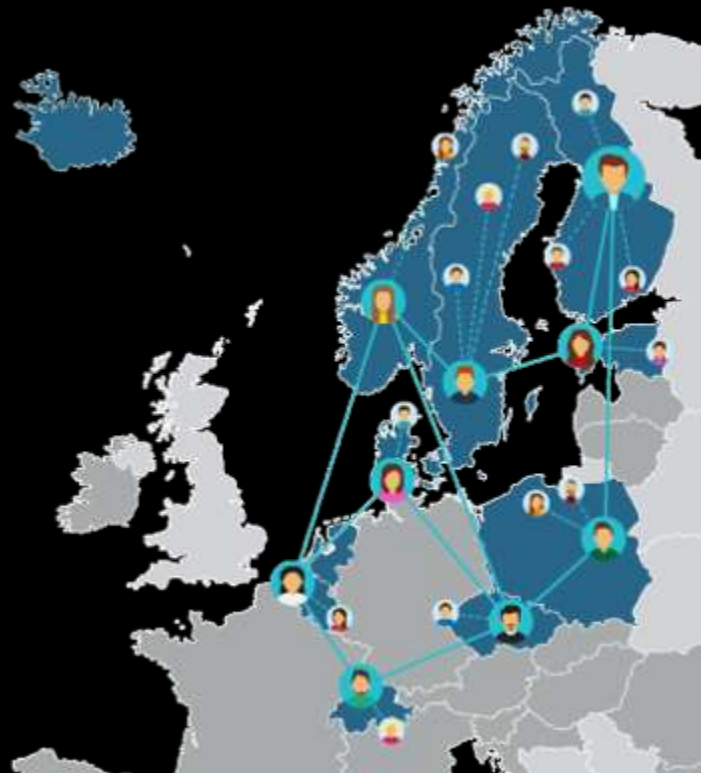


# LUMI User Support Team

**Porting & optimization**

- CoE (HPE & AMD) + LUST effort
- 6 projects in 2022-2023: QuantumEspresso, Megatron-LM, SLIM, tmLQCD & PLEGMA, GPAW
- 5 projects in 2023-2024: TurboGAP, Vlasiator, Genesis, HMSC & SIESTA
- 5 projects in 2024-2025: Elmer, FLEXI/Galaexi, SOD2D, Exciting, SPH-EXA

- Interviews
- Consultancy
- Testing
- Optimization



# LUMI AI Factory

## Introduction

# EU promotes AI innovation

LUMI AI Factory

- European Commission launched the AI Innovation Package in January 2024 to support European startups, and SMEs in the development of trustworthy AI
- A series of competitive calls for AI Factory proposals – first seven announced in December 2024 and further six in March 2025
- AI Factory = **compute** + **data** + **talent**
- AI Factories focus on certain **AI ecosystems and communities in** alignment with **national AI strategies**

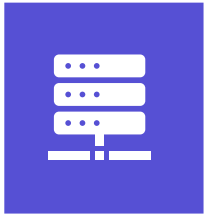


***The EuroHPC AI Factories initiative*** *– a one-stop shop to offer AI startups, SMEs, and researchers comprehensive support, including access to AI-optimised high-performance computing (HPC) resources, training, and technical expertise.*

# Empowering Europe's AI ecosystem

LUMI AI Factory

Our vision: To create a comprehensive and accessible service infrastructure that empowers AI start-ups, SMEs, academic researchers, and other public and private users to develop innovative AI models and applications.



Leverage the established LUMI system, install a new AI-optimized supercomputer, and an experimental quantum computing platform for quantum-accelerated AI workloads.

Create a world-class computing environment and access to completely new data sources, together with a service center and talent pool to support the development of new AI solutions.

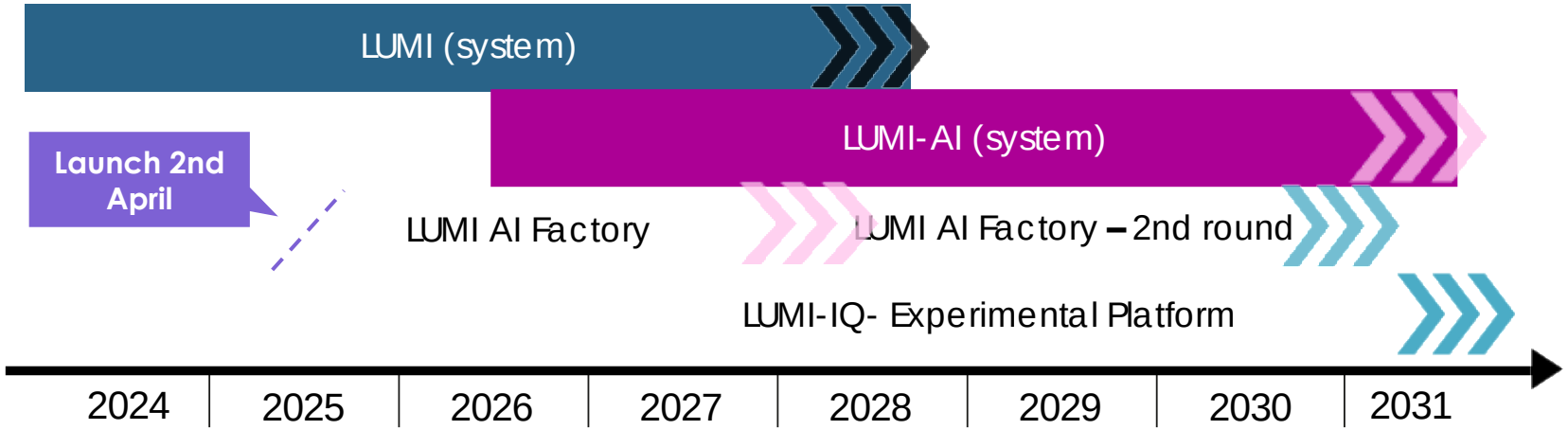
# LUMI AI Factory

LUMI AI Factory

- The three pillars of LUMI AI Factory
  - AI-optimised supercomputer **LUMI-AI**
  - AI Factory **Service Center**
  - Experimental quantum-computing platform **LUMI-IQ**
- CSC (Finland) coordinates consortium with participation from Czechia, Denmark, Estonia, Norway and Poland
  - Other Finnish partners are FCAI (Aalto University, University of Helsinki) and AI Finland (Technology industries)
- Total budget over 612 million euros
  - EU 306.4 M€, FI 250 M€, CZ 11 M€, DK 10 M€, EE 5 M€, NO 20.4 M€, PL 10 M€
  - largest public computing ecosystem investment in Finland, among the largest in Europe
  - largest EuroHPC AI Factory investment
- Significant investment in talent and competence development

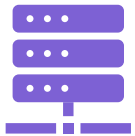
# Timeline for the LUMI AI Factory

LUMI AI Factory



# Services – data and computing

LUMI AI Factory



**Computing capacity**

- Massive GPU, AI inference, multi-tenant environment, fast storage
- Quantum capacity for AI through the LUMI-IQ experimental platform
- Fast lane for ambitious AI startups

**Data access**

- Cloud-like data environment
- Public and restricted data, dynamic data
- Datasets-as-a-service dataset hosting
- Data spaces and other infrastructures

**Data support**

- Data wrangling, MLops
- Deep support for AI methods, scalability

# Services – people and talent

LUMI AI Factory

## Training

- Structured training paths for AI and HPC, tailored training for different domains
- Collaboration with AI centers

## Co-working spaces and student facilities to nurture talent

- Main hub on grounds of Aalto University together with ELLIS Institute
- A distributed network connected to partner countries

## Consultation (company focus)

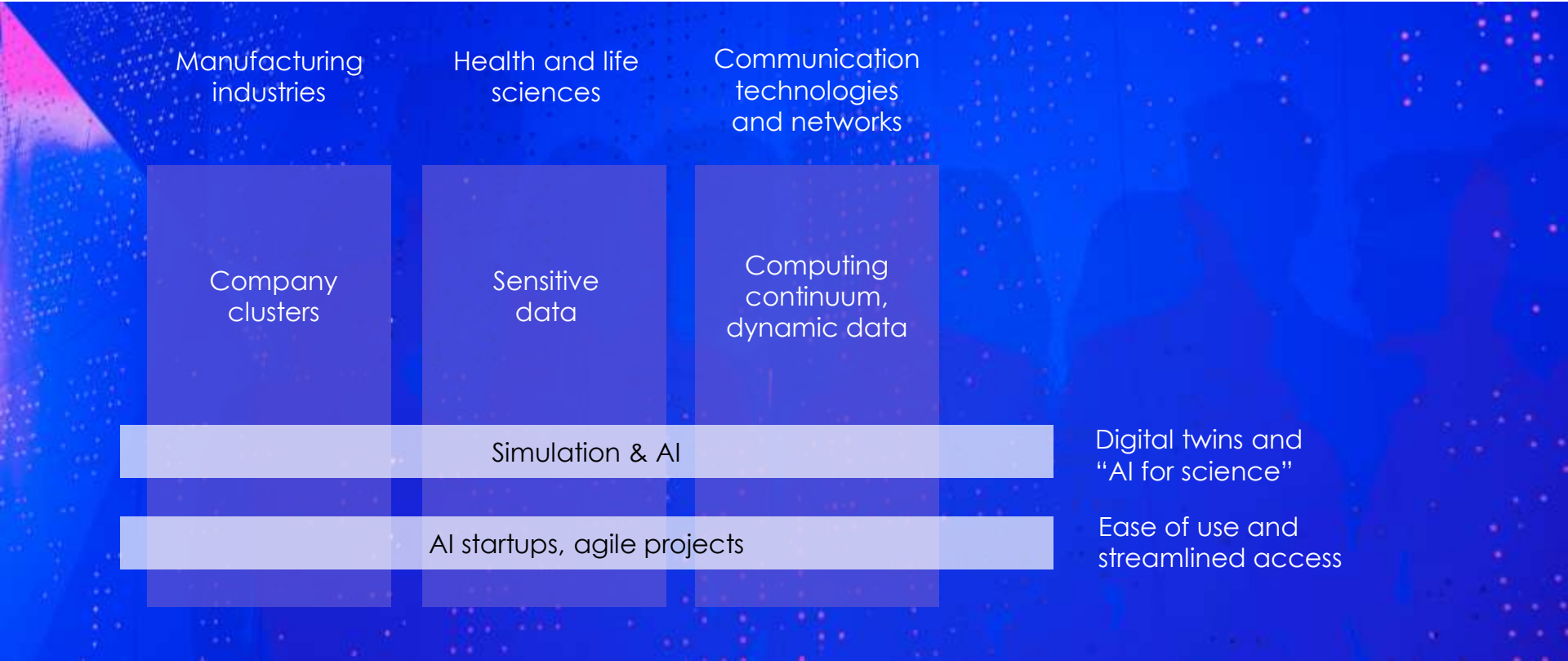
- Getting started, feasibility analysis
- Support in applying for large resources
- Trustworthy AI: regulatory consultation, compliance, sandboxes
- Ecosystem development

## Focus on competence development

- Support both scientific researchers and industrial innovators to adopt AI methods on a large scale

# Key industrial sectors and focus areas

LUMI AI Factory



LUMI

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EuroHPC Joint Undertaking

The acquisition and operation of the EuroHPC supercomputer is funded jointly by the EuroHPC Joint Undertaking, through the European Union's Connecting Europe Facility and the Horizon 2020 research and innovation programme, as well as the Participating States FI, BE, CH, CZ, DK, EE, IS, NL, NO, PL, SE.

Leverage from the EU 2014–2020

European Union

REGIONAL COUNCIL OF KAINUU