Czech AI Factory

LETNÍ ŠKOLA CZAI

7.–11. 9. 2026

EuroHPC Joint Undertaking
Spolufinancováno Evropskou unií
Ministerstvo školství, mládeže a tělovýchovy

EUROHPC JOINT UNDERTAKING

VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

Established in 2018

Czechia is member since January 2018

Composed of 38 member states, 3 private members (ETP4HPC, BDVA, QuIC) and EU

EuroHPC Joint Undertaking

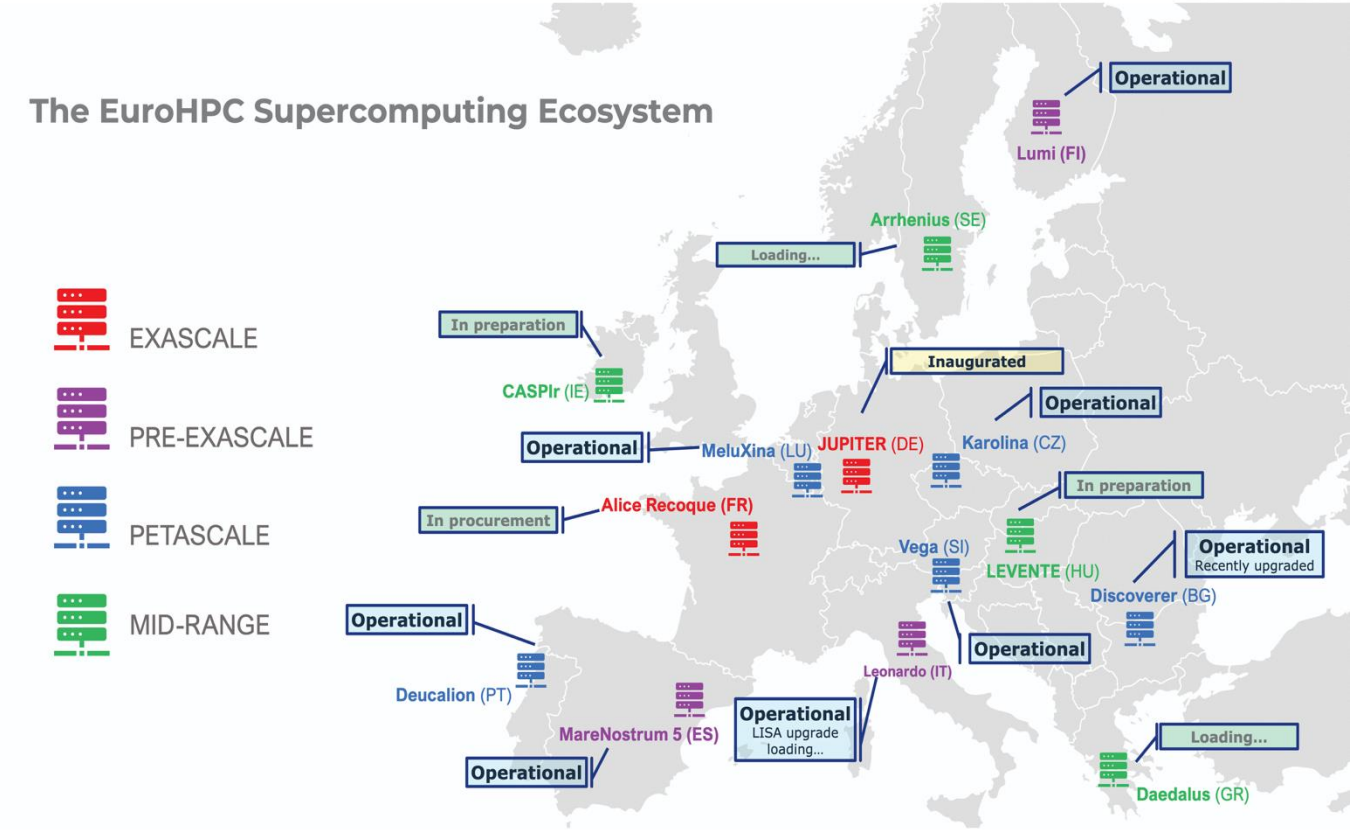
EuroHPC goals

A federated HPC/QC/AI infrastructure

European Technologies & Applications for the HPC ecosystem

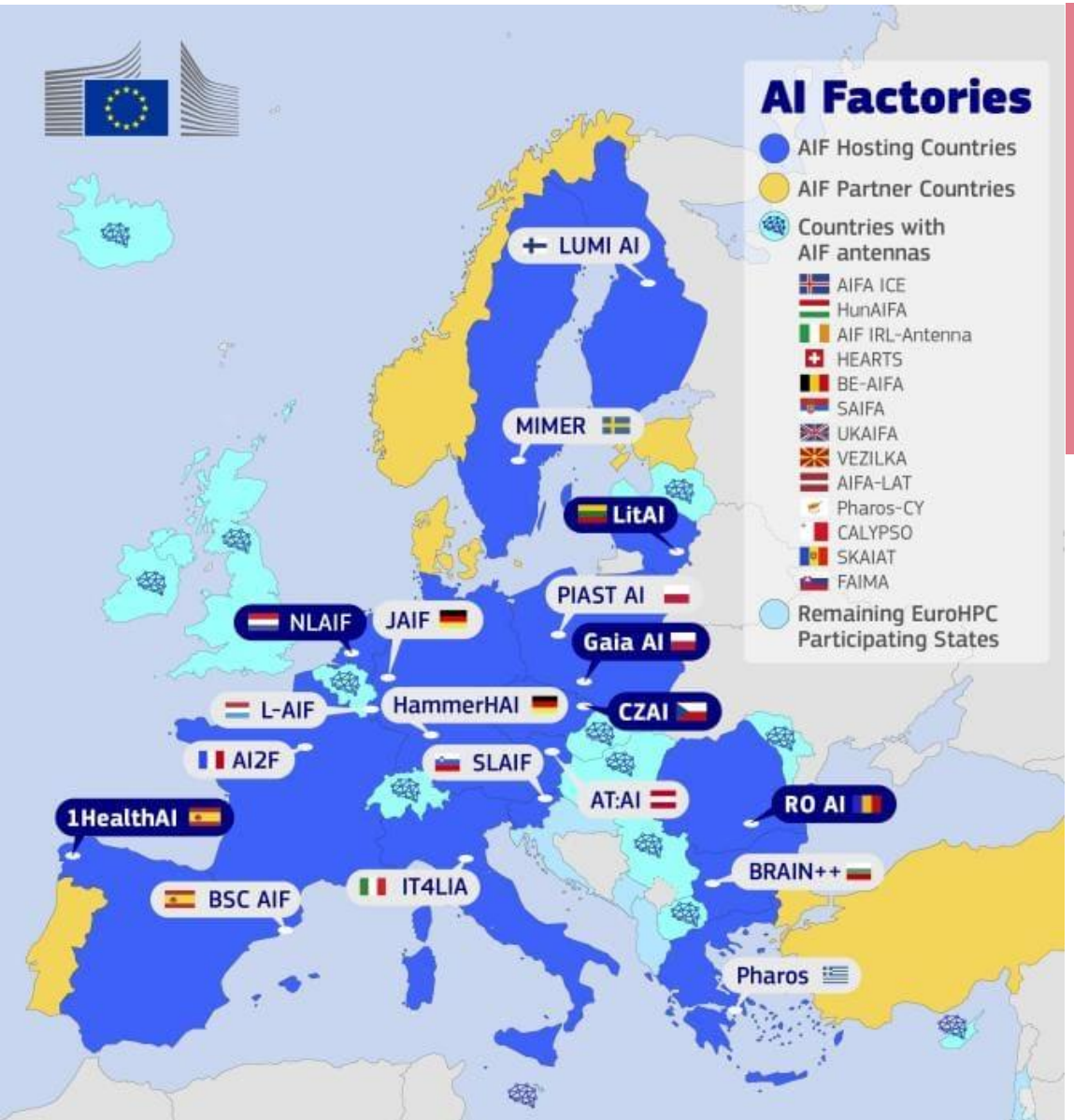
Leadership in HPC/QC/AI use and skills

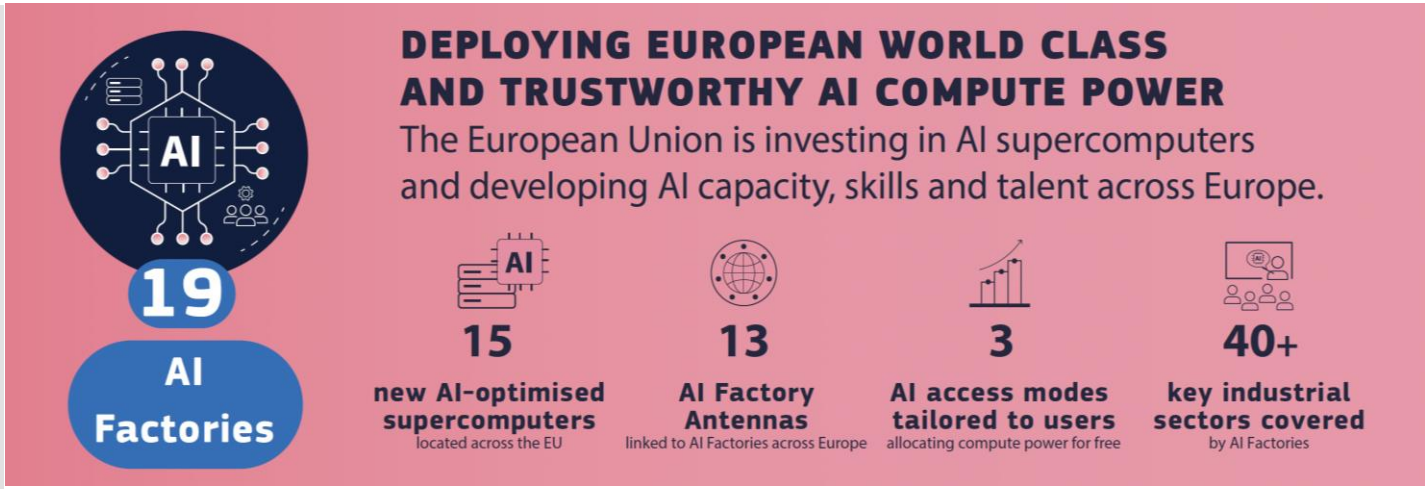
NEW
AI Factories & Gigafactories
Quantum Technologies

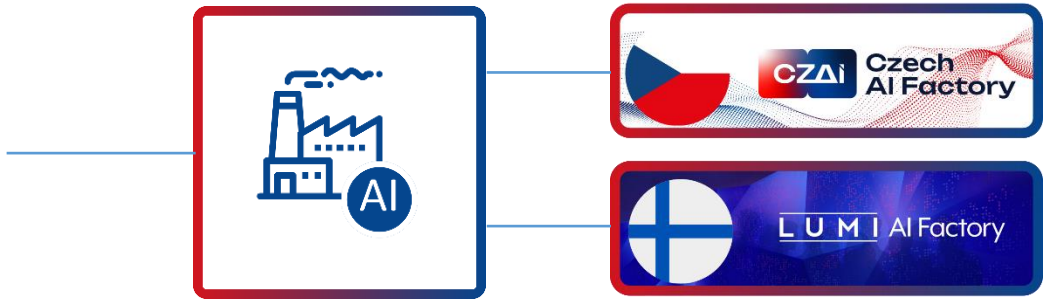


EUROHPC AI FACTORIES

Czech AI Factory







EuroHPC Joint Undertaking

Co-funded by the European Union

Ministry of Education, Youth and Sports of the Czech Republic

ČESKÁ BRÁNA K EVROPSKÉ AI

Czech AI Factory

VSB TECHNICAL UNIVERSITY OF OSTRAVA
CTU CZECH TECHNICAL UNIVERSITY IN PRAGUE
INDRC
ÚOCHB AV ČR IOCB PRAGUE
Charles University
BRNO UNIVERSITY OF TECHNOLOGY

- Smart manufacturing
- Health & Life Sciences
- Sustainable Energy
- Public Administration
- Cybersecurity
- Future Mobility

Startups and SMEs | R&D | Public administr. | Industry

Main Pillars

- The AI-optimized supercomputer KarolAIna with a total performance of approximately 850 PFlop/s in standard AI operations
- The AI Factory Service Centre

Services

- Access to computing power,
- Data and case analysis,
- Design, training,and tuning of AI models,
- Data collection
- Inference services
- AI task execution,
- Technical support and AI assistant,
- Specialized training and legal consulting.

Total budget

- Approximately 40 million EUR, funded 50/50 by the EuroHPC Joint Undertaking and the Czech Republic.

KDO SE MŮŽE NA CZAI OBRÁTIT?

Czech AI Factory

- STARTUP
- MALÁ A STŘEDNÍ FIRMA
- VELKÁ FIRMA
- VEŘEJNÁ ORGANIZACE
- VÝZKUMNÝ TÝM

- **ZAČÍNÁTE**
  Nevíte ještě, kde může AI pomoci?
- **EXPERIMENTUJETE**
  Máte první nápad nebo pilot?
- **NASAZUJETE A ŠKÁLUJETE**
  Chcete AI řešení rozšířit a zprovoznit?
- **ROZVÍJÍTE POKROČILOU AI**
  Potřebujete špičkovou infrastrukturu?

CZAI je pro toho, kdo chce AI posunout dál

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Ministerstvo školství, mládeže a tělovýchovy

AI CAMPUSES A TRAINING ACADEMY

Praha

AI Campus na CIIRC ČVUT

nově vzniká

Brno

AI Campus na FIT VUT

nově vzniká

Ostrava

AI Campus na VŠB-TUO

vznikl v rámci LUMI AI Factory

Kampusy nabízejí

co-working, mentoring od zkušených výzkumníků, témata závěrečných prací a onboarding na KarolAInu

Sezónní školy

týdenní intenzivní workshopy jednou ročně, postupně v Ostravě, Brně a Praze, zhruba 30-40 studentů na akci

Certifikace

certifikáty a mikrokredity, část kurzů v souladu s evropským kreditovým systémem ECTS

Česky

nejméně polovina školicích materiálů se překládá a kulturně adaptuje do češtiny

CZAI LETNÍ ŠKOLA – PROGRAM

Program sestává z bloků po 90 minutách. Součástí je oběd a přestávky na kávu.

Pondělí
- Úvod do HPC, připojení na superpočítače (IT4I)
- Příprava dat pro strojové učení (IT4I)
- Networking a návštěva infrastruktury IT4I
- Společná večeře

Úterý
- Physical AI v praxi: Od AI modelu k humanoidnímu robotovi (ČVUT)
- Od chatu k agentovi / Co váš model ví, ale neřekne vám to (MICROSOFT)

Středa
- Současné trendy v ověřování a extrakci reprezentací mluvčího / Automatického rozpoznávání řeči (VUT)
- Nástroje usnadňující trénování a inferenci AI modelů na superpočítačích (IT4I)
- Návštěva Planetária s promítáním a večeří

Čtvrtek
- Projekt OpenEuroLLM a evropské otevřené modely, obtížnost vyhodnocování výstupů LLM (UK)
- Důvěryhodné Bayesovské AI modely a AI pro enzymy (ÚOCHB)

Pátek
- Propojení světa akademie a průmyslu / Odpovědná a důvěryhodná AI a bezpečnost AI agentů (INDRC, IT4I)

Místní organizátoři: Tomáš Kozubek, Karina Pešatová, Veronika Pakostová

Czech AI Factory

AI SLUŽBY, EXPERTI A SUPERPOČÍTAČOVÝ VÝKON PRO VÁŠ TECHNOLOGICKÝ NÁSKOK

INFO@CZAI.AI

CZAI.AI

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INTRODUCING IT4INNOVATIONS

VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

Established in 2011 within ESI Funds project

5 partners led by VSB-Technical University
of Ostrava to build national supercomputing center

Unit of the VSB – Technical University of Ostrava

More than 250 employees

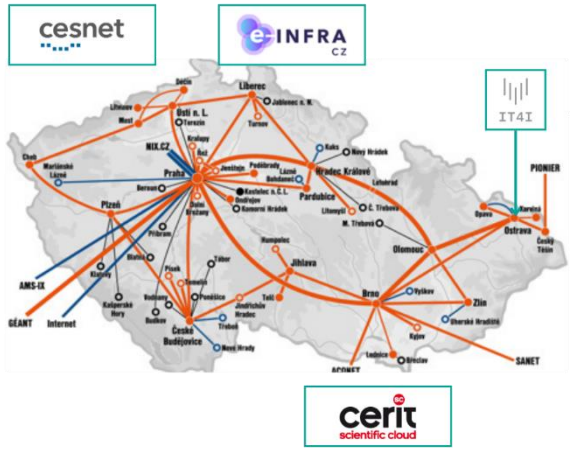
200+

Supercomputing services (12%)
5 research laboratories (64% in ADAS, INFRA, PAR, NANO, QC)
Management and administration (24%)

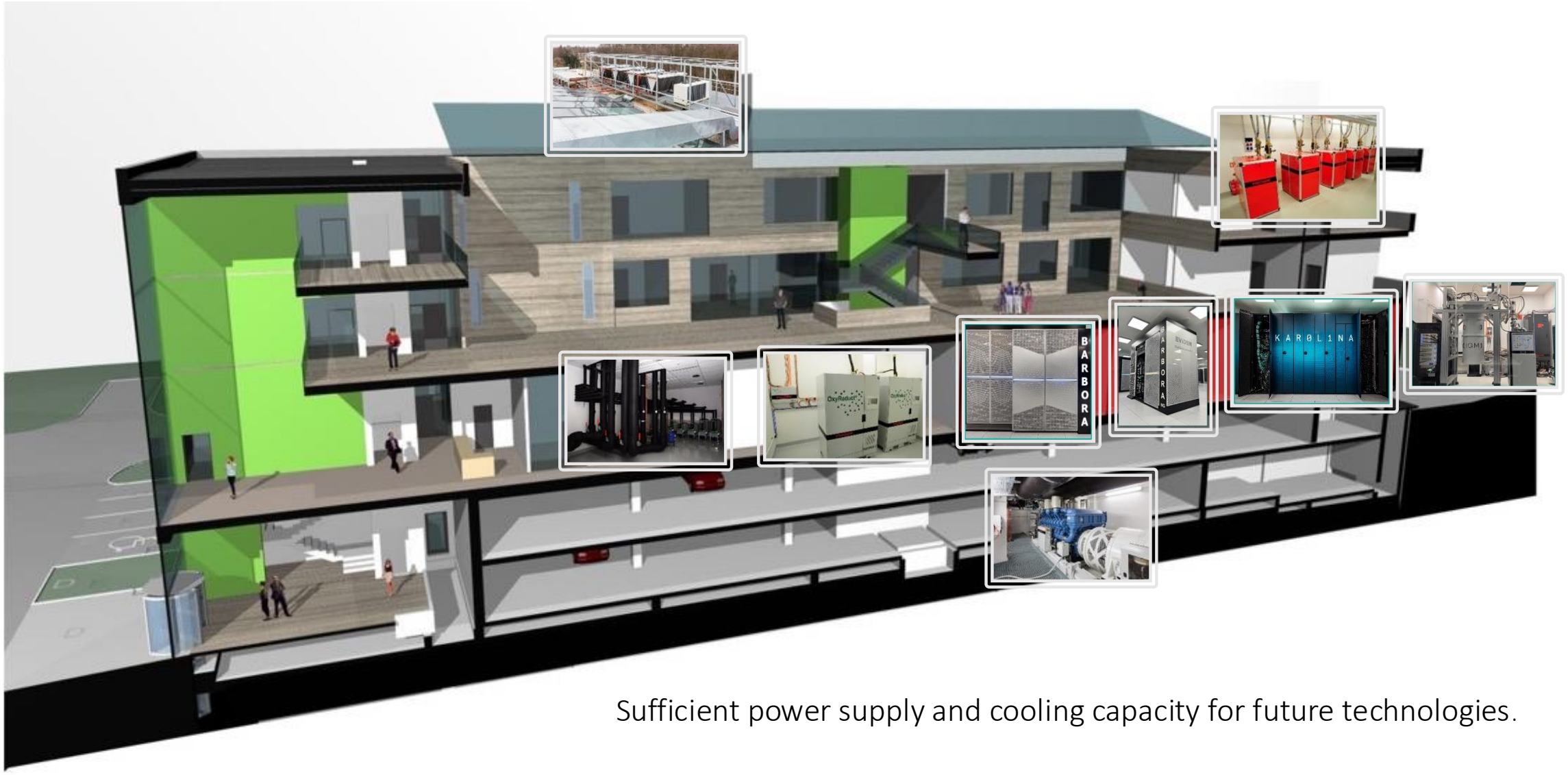
Member of e-INFRA CZ

a strategic large research infrastructure of Czechia
Networking / Computing/ Data technologies
and services HPC / HPDA / AI / QC at IT4I

Member of many international infrastructures, associations, and initiatives



GUIDED TOUR OF SC, QC, AND SUPPORTING INFRASTRUCTURE



Sufficient power supply and cooling capacity for future technologies.

IT4INNOVATIONS HPC AND QC SYSTEMS

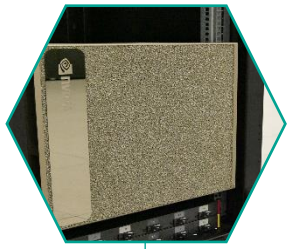
VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

2011 * IT4I

July 2013 — **Anselm**
0.1 PFlop/s

July 2015 — **Salomon**
2 PFlop/s, #40

March 2019 — **DGX-2**
2 PFlop/s AI



October 2019 — **Barbora**
0.8 PFlop/s

August 2021 — **Karolina**
15.7 PFlop/s, #69

EuroHPC Joint Undertaking

Autumn 2021 — **LUMI**
550+ PFlop/s , #3

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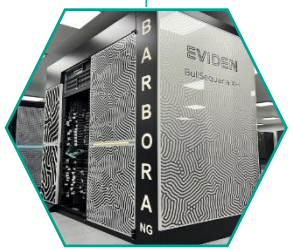
September 2025 — **VLQ**
Quantum Computer

EuroHPC Joint Undertaking

Q2 2026 — **Barbora NG**



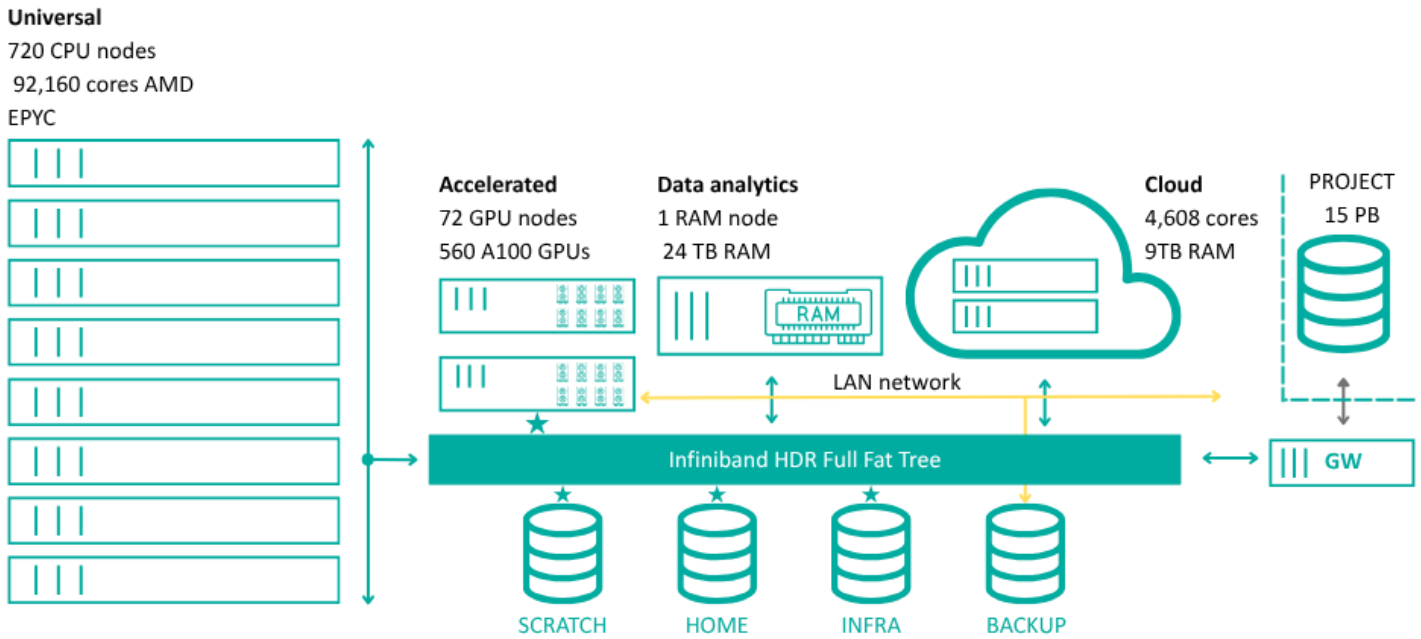
KAROLINA SUPERCOMPUTER

EuroHPC Joint Undertaking

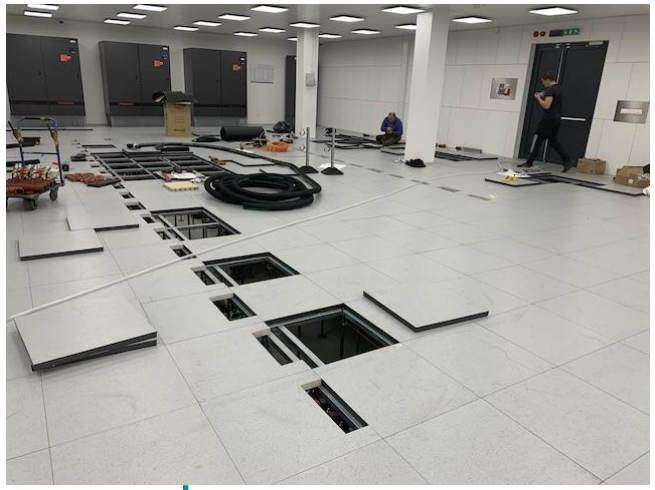
VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

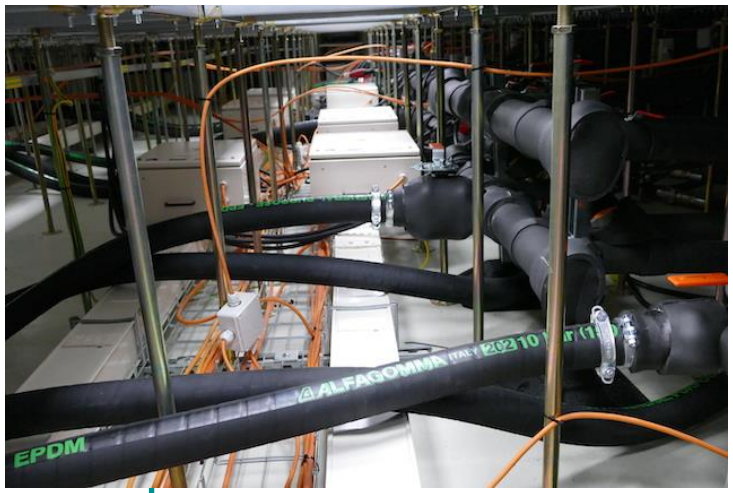
- Manufactured by Hewlett Packard Enterprise
- In operation from 2021, #69 in TOP500, #8 in GREEN500
- EuroHPC supercomputer by HPE
  - 65% Czech funding
  - 35% EU funding (for EuroHPC users)
- Total investment approx. EUR 15 million

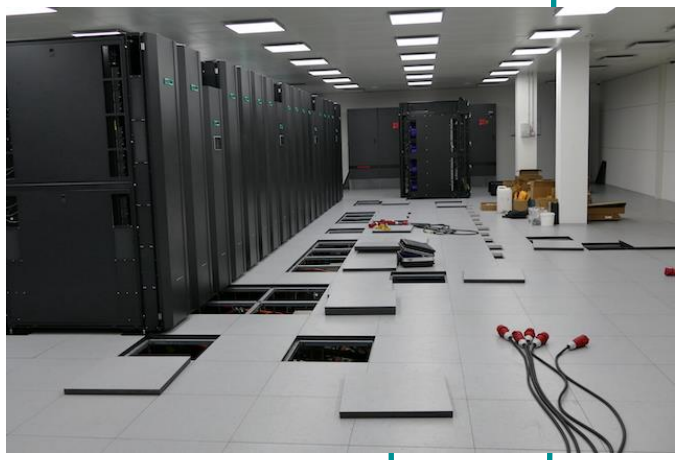
- Total theoretical performance 15.7 PFlop/s
- Used by more than 2,500 users to solve more than 700 projects and consumed more than 7 million node-hours of computing time
- Expected end of operation for EuroHPC users 2026



KAROLINA – INSTALLATION







First phase acceptation

Final acceptation

December 2020

January 2021

February 2021

April 2021

July 2021

LUMI: ONE OF THE MOST POWERFUL IN EUROPE

VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

- Manufactured by **Hewlett Packard Enterprise**
- Total budget: 207.1M€ **(50 % EuroHPC JU)**
- #3 in TOP500 and GREEN500 in 2022
- Period of operation: 2021–2026
- Consortium: **FI (CSC in Kajani)**, SE, NO, DK, BE, PL, CH, **CZ**, EE, IS, NL
- Ca **2,5% of the resources available to the Czech users** through IT4I Open Access calls

EuroHPC Joint Undertaking

454784 AMD EPYC CPU cores,
11912x GPU AMD Instinct MI250X, 128GB HBM2e

1 system

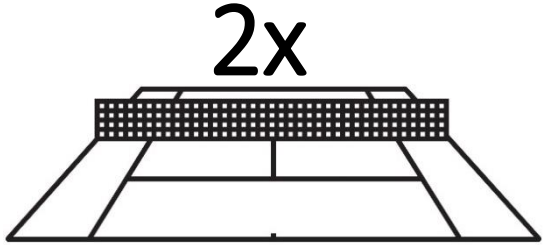
531.5 PFlop/s

peak performance

Computing power equivalent to

1 500 000

modern laptop computers



2x size of a tennis court

Modern platform for:

High-performance computing,
Artificial intelligence,
Data analytics

Based on GPU technology

BARBORA NG

VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

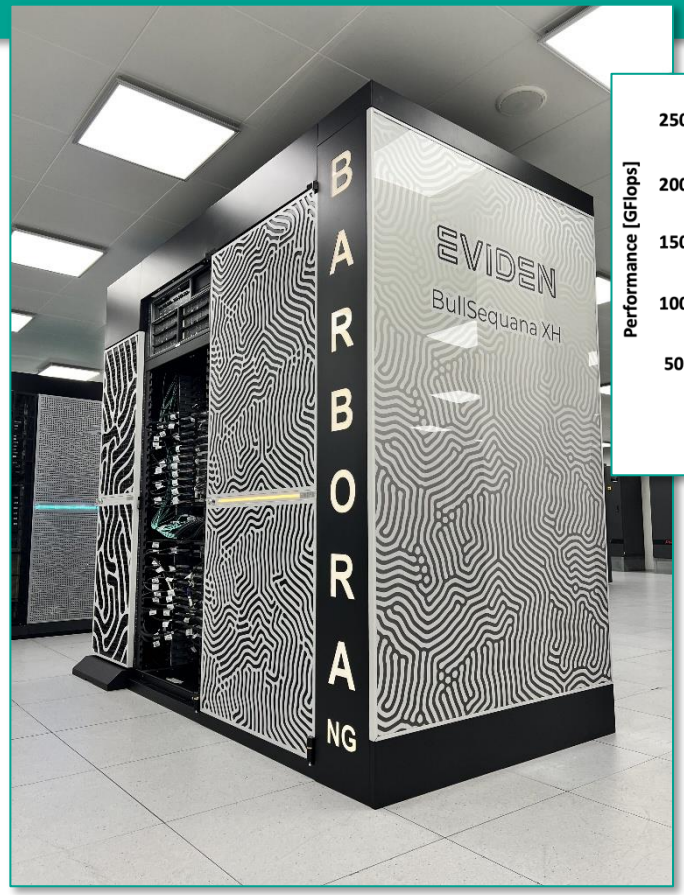
Investment

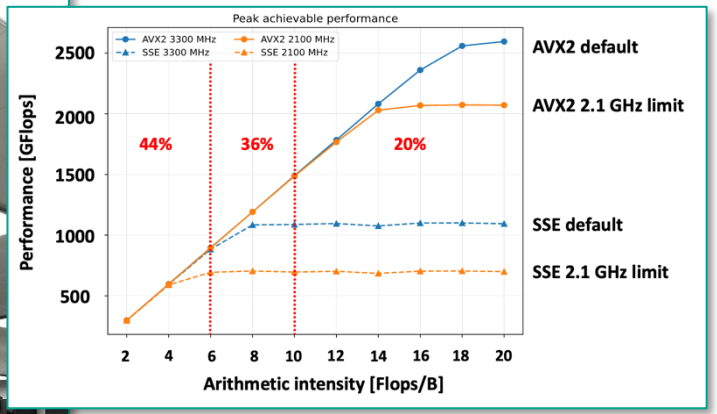
- CZK 91 million (funded through the OP JAC)
- Operational in 2Q 2026

CPU only cluster

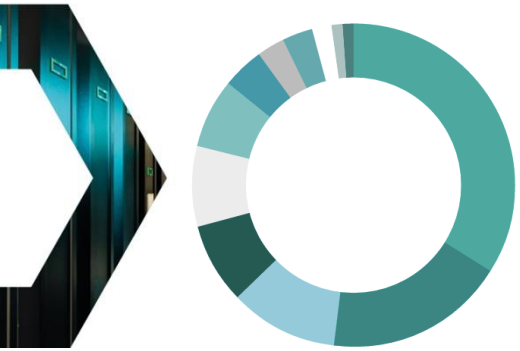
- Based on Eviden BullSequana XH3000
- 144 nodes with Intel Granite Rapids 2.1 GHz (Intel Xeon 6952P)
- 2 processors per node and 96 cores per processor = 27648 cores
- DDR5 RAM with MCR ECC 8800MT/s
- RAM capacity 768GiB per node
- Fat Tree Infiniband NDR (400 Gb/s)

Enhanced ultra-energy-efficient Direct Liquid Cooled solution with warm water input of **up to 40°C and over 97%** heat dissipation into water from compute nodes

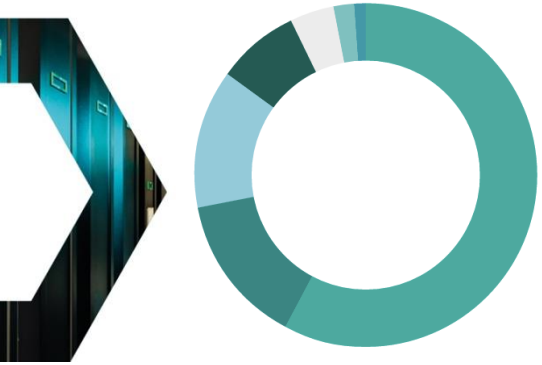




USERS FROM ACADEMIA



- 34% Czech Academy of Sciences (50 projects)
- 18% VSB – Technical University of Ostrava (30 projects)
- 11% Brno University of Technology (24 projects)
- 8% Masaryk University (11 projects)
- 8% Czech Technical University in Prague (38 projects)
- 7% Charles University (25 projects)
- 4% Palacký University in Olomouc (13 projects)
- 3% University of Chemistry and Technology in Prague (8 projects)
- 3% CESNET (1 project)
- 2% University of Ostrava (4 projects)
- 1% CEITEC (7 projects)
- 1% Others (ELI Beamlines, University of South Bohem



- 58% Material sciences (91 projects)
- 14% Physics and astronomy (24 projects)
- 13% Computer science (32 projects)
- 8% Biosciences (35 projects)
- 4% Earth sciences (13 projects)
- 2% Applied mathematics (14 projects)
- 1% Engineering (12 projects)

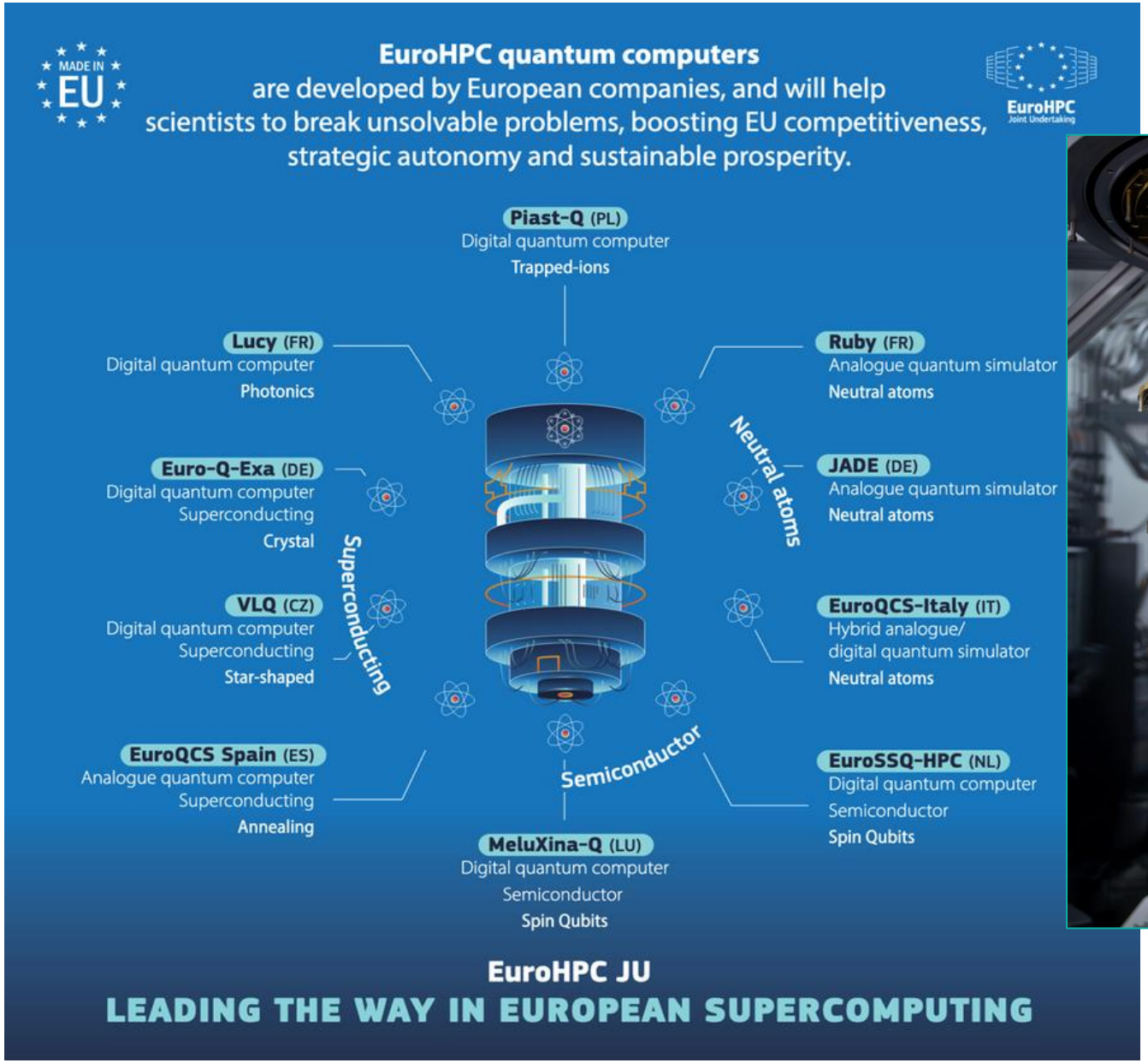
ACCESS to supercomputers
(Karolina, Barbora, Barbora NG, LUMI)

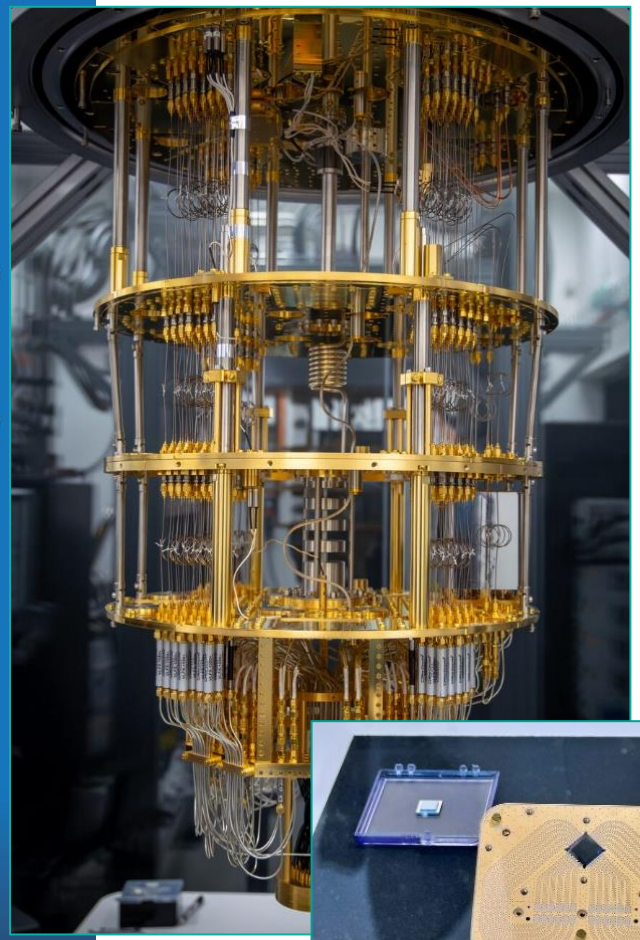
Open access
(Regular every 4 months | Fast Track continuous)
Allocation of the computational resources to the research community in Czechia based on scientific excellence, computational competence and readiness, and anticipated benefits to society and the economy.

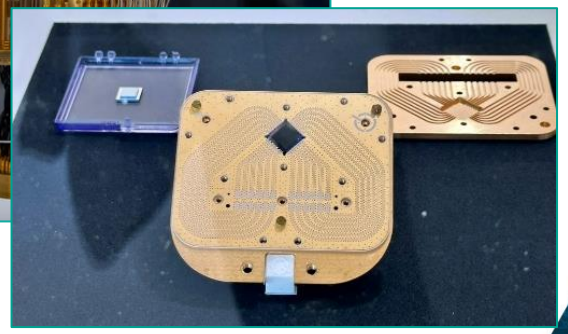
Thematic access
(continuous)
Societal and economic needs incl. cooperation with industry, education, …

EuroHPC JU access
Regular, Extreme Scale, Benchmark, and Development Access, and AI for Science and Collaborative projects

EUROHPC QUANTUM COMPUTERS







VLQ QUANTUM COMPUTER

EuroHPC Joint Undertaking

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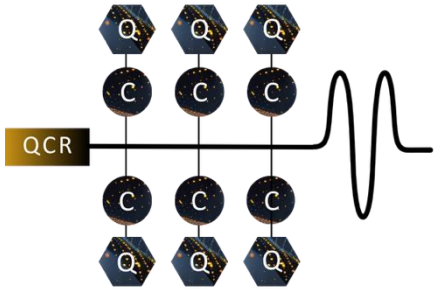
LUMI-Q

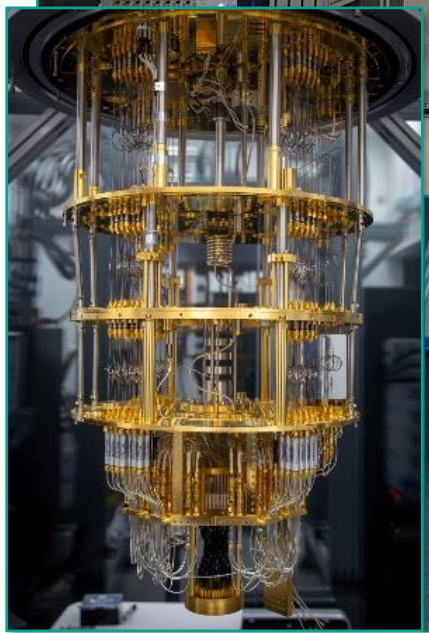
1st quantum computer in Czechia

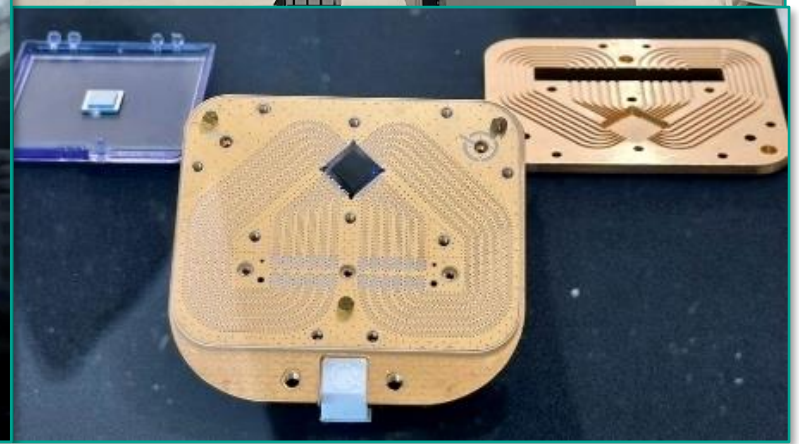
Superconducting qubits

Star-shaped topology

24 physical qubits







ATLAS OF QUANTUM COMPUTING APPLICATIONS

VLQ LUMI-Q

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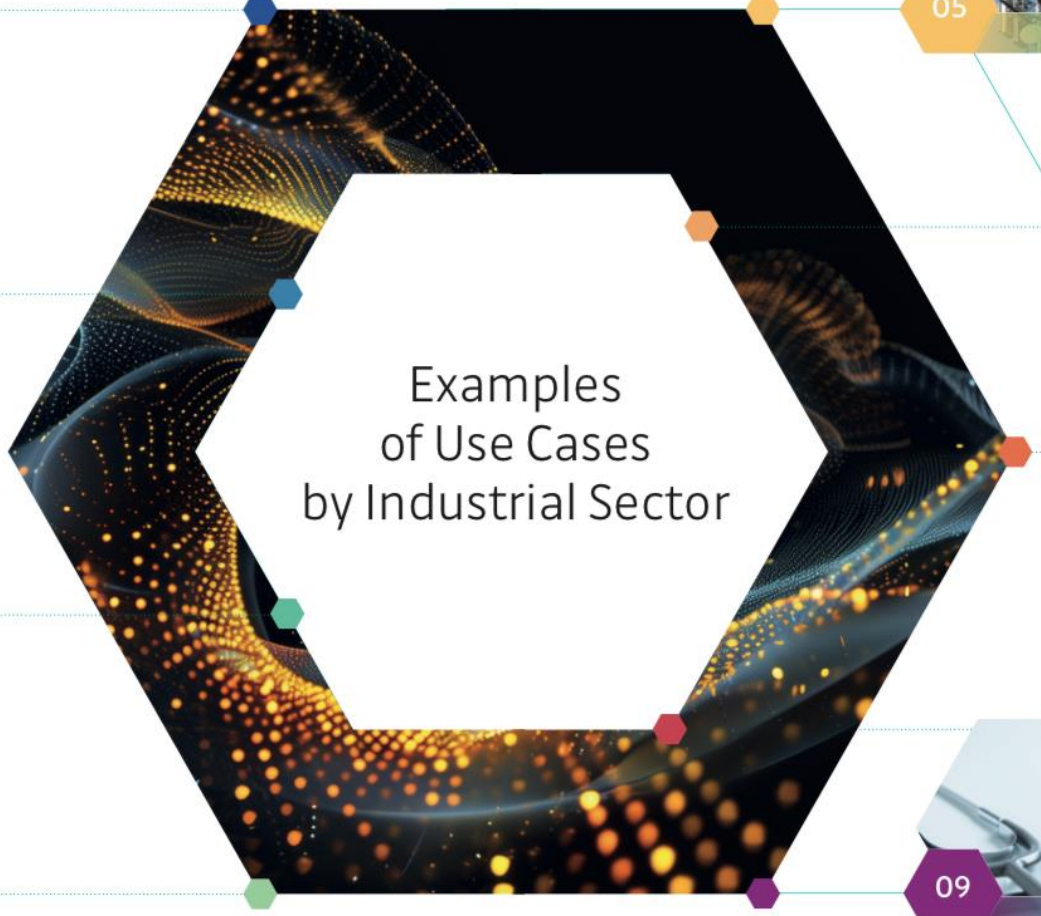
https://www.it4i.cz

01 Finance

02 Pharmaceutical Industry

03 Energy

04 Automotive Industry



05 Telecommunications

06 Logistics

07 Chemical Industry

08 Manufacturing Industry

09 Healthcare

IT4INNOVATIONS RESEARCH FLAGSHIPS

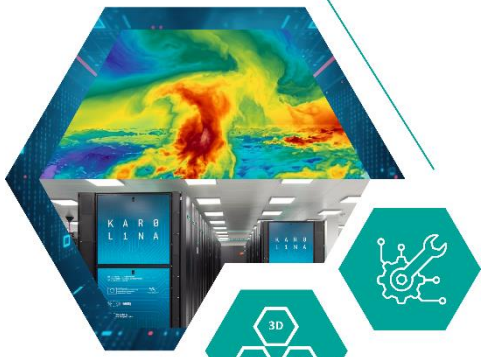
VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

CADENCE

Computationally Accelerated Discovery of Advanced Materials and Biomolecular Systems

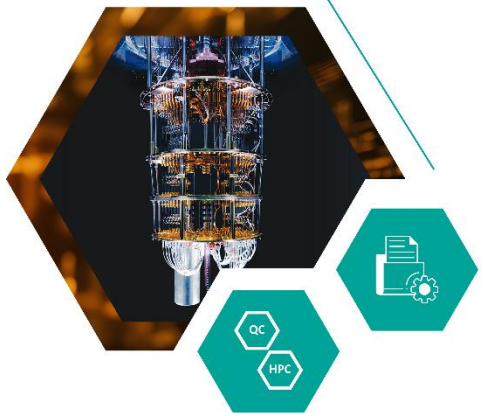
AURORA

Artificial Intelligence for Unified Representation, Observation, Rendering and Advanced Simulation



HPQC4F

High Performance and Quantum Computing for Future



LEXIS PLATFORM

Flagship advances Europe's leadership in data-driven research

MERIC

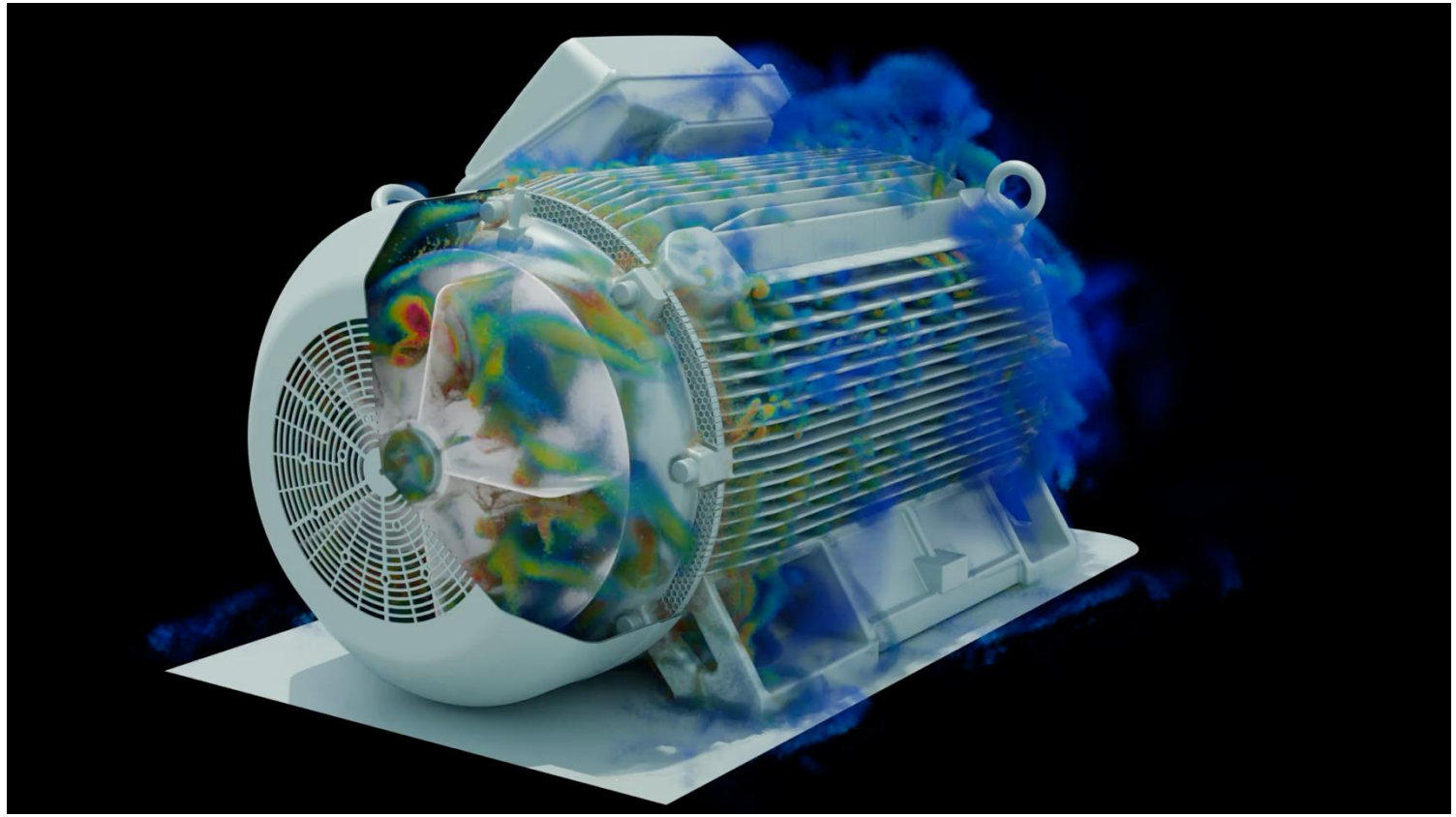
Energy efficiency software suite for data centres

AURORA DIGITAL TWIN OF SIEMENS ELECTRIC MOTOR

VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

Complex nonlinear multiphysical problem

- Electric fields
- Electromagnetism
- Heat transfer
  - heat generated by magnetism
  - cooling system
- Structural Mechanics
  - structural integrity
  - vibration from motion
  - high speed motors
  - influenced by electromagnetism
- Active cooling system
  - fluid flow
- Acoustic
  - generated by fluid flow
  - generated by electromagnetism
  - generated by vibrations



SIEMENS

One complex transient simulation

- Salomon: 1200 CPU cores **by open source code,** 35 hours
- Workstation: 256GB RAM, 30 cores, more than 2 months!

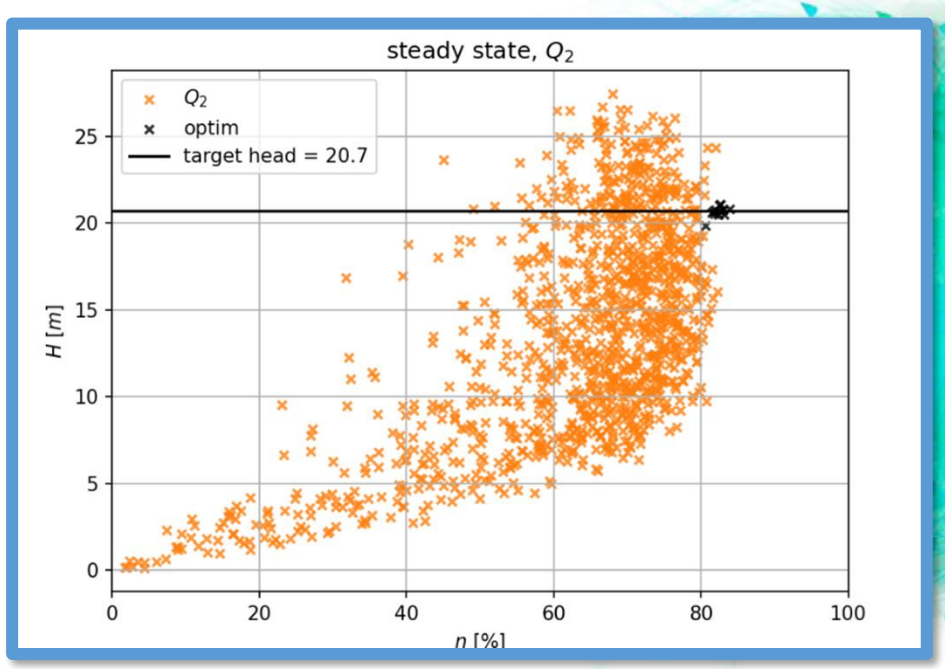
Further acceleration:

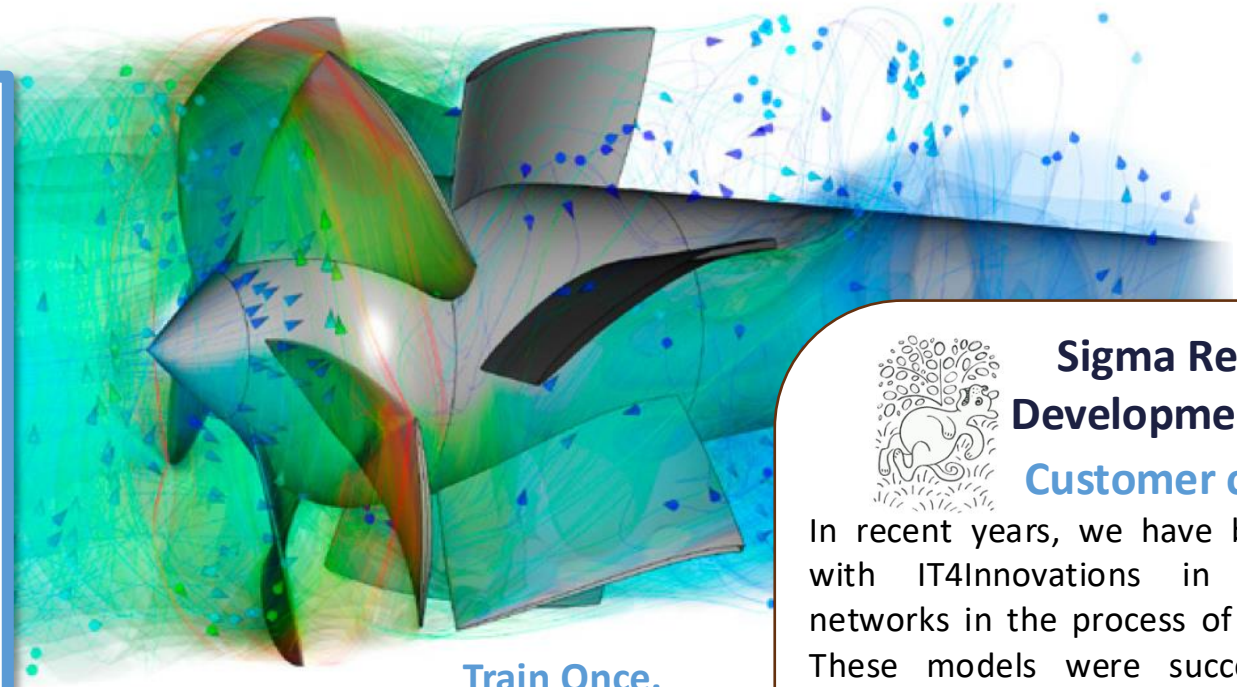
AI based surrogate models

SHAPE OPTIMISATION: OPTIMAL DESIGN ACCELERATION

VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

Vertical Water Pump **Shape** Optimization





Train Once.
Optimise Many Times.

Steady-state CFD: **18 h**

Transient CFD: **50 h**

Multiple flow rates needed per shape

NN: a bridge between steady-state and transient physics

Cheaper steady-state CFD data estimates richer transient behaviour

AI surrogate: predictions in **milliseconds**

Genetic algorithm finds optimal design

CFD simulation validates result!

Sigma Research & Development Institute

Customer comment:

In recent years, we have been cooperating with IT4Innovations in utilizing neural networks in the process of hydraulic design. These models were successfully used to improve design speed and quality.

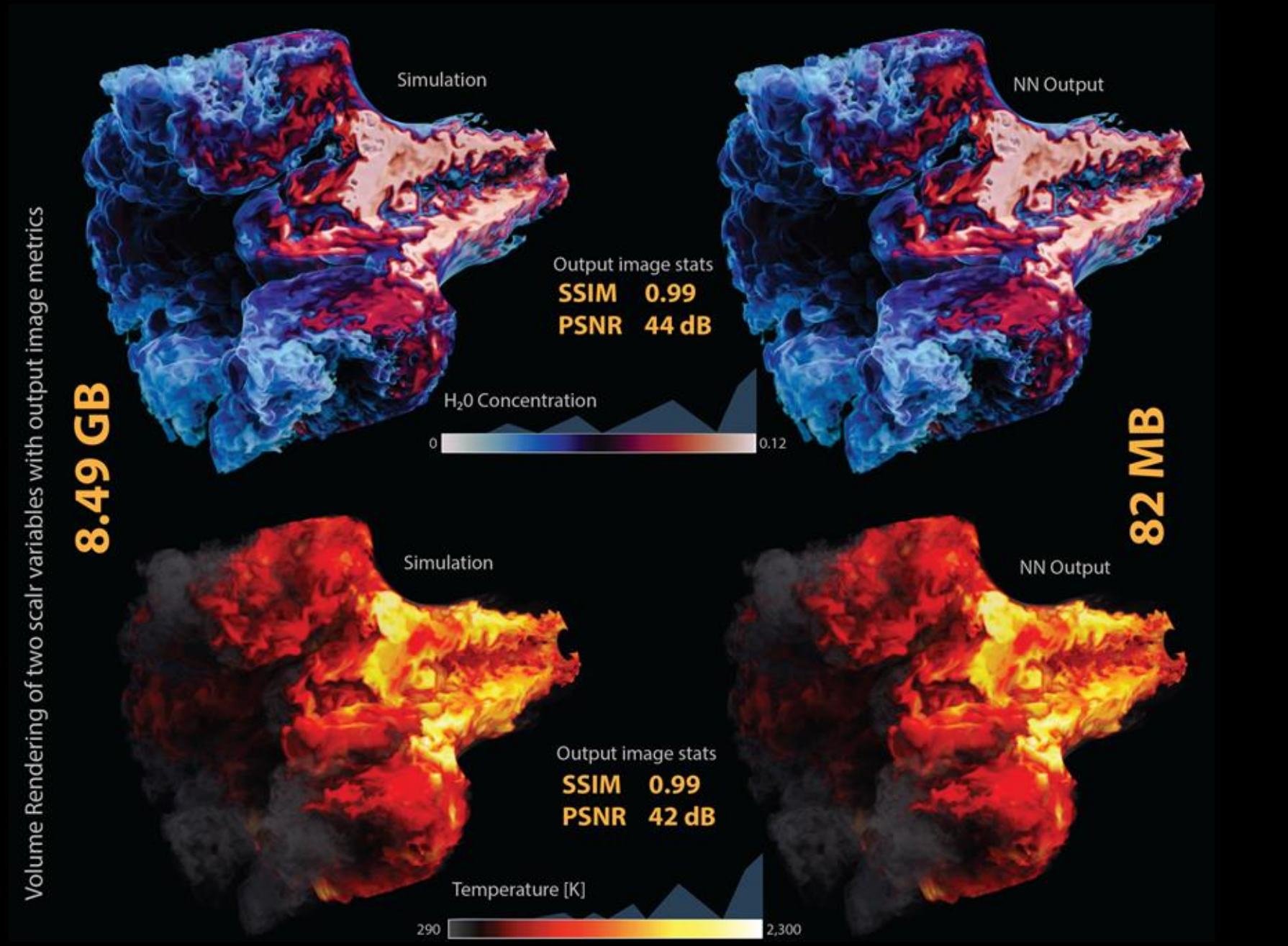
Thanks to this, we are gradually implementing these results in our hydraulic design routines. We also appreciate the high level of expertise and experience demonstrated by the IT4Innovations team in its cooperation with industry partners.

Tomáš Krátký

Deep learning for scientific data compression

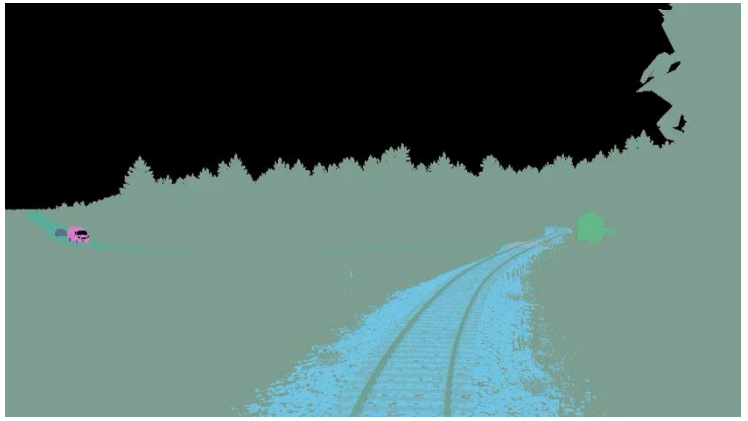
Long-term storage of high-fidelity volumetric data

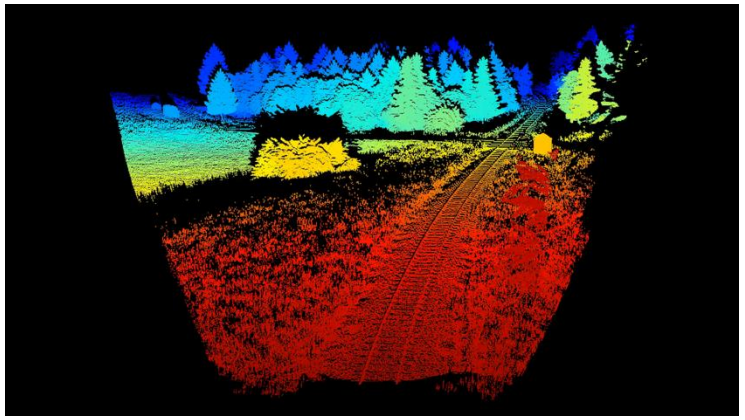
Memory-efficient rendering



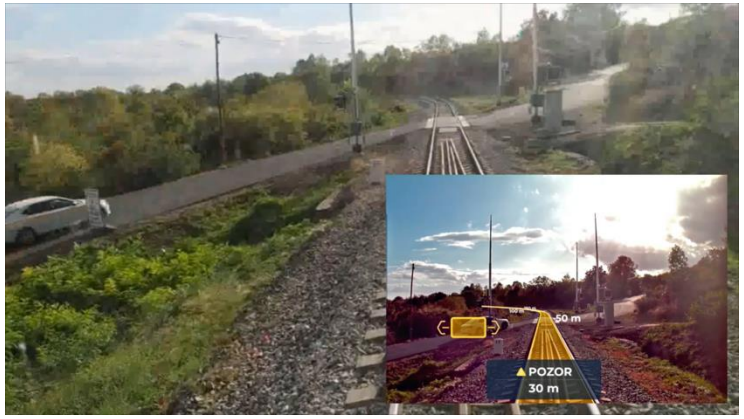
GENERATION OF SYNTHETIC IMAGE DATA FOR INDUSTRIAL APPLICATIONS USING AI

- Development of a software simulator capable of generating training data for an obstacle detection system on a railway track





Synthetic data



Application

T A
Č R

IXPERTA

MERIC ENERGY EFFICIENT HPC SW SUITE

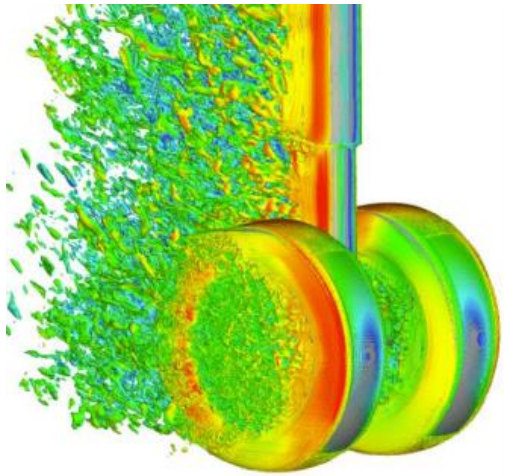
VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

Parallel application behaviour analysis & optimisation

SCALABLE
EuroHPC JU project

AIRBUS
Customer

ProLB
Used code for CFD



Energy optimisation of ProLB using MERIC

	No penalty	With penalty
Runtime [%]	+0.5%	+4.1%
Energy [%]	-12.1%	-19.5%

Contractual research

DEUCALION

EuroHPC system in Portugal
- deployment of MERIC suite
- 32 400 EUR

Partners

EXELIZ SOLUTIONS
FUJITSU
EVIDEN

Datacenter monitoring & optimization

KAR0L1NA

- Karolina system – power consumption ±780 kW
- 103 kW power savings equals to 883 MWh / year
- 1MWh ~ 6000 CZK => 5.4 M CZK
- annual 315t CO2e reduction equals 12 600 trees

LEXIS PLATFORM

LEXIS2 Platform

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Easy access to HPC and Cloud computing

- Web based GUI for all features of the platform
- HPC-as-a-Service approach – REST API for all features of the platform

Complex computing workflows across HPC and Cloud

- Workflow orchestration on federated HPC using *Apache Airflow and HEAppE*
- Secure access to HPC resources through REST API

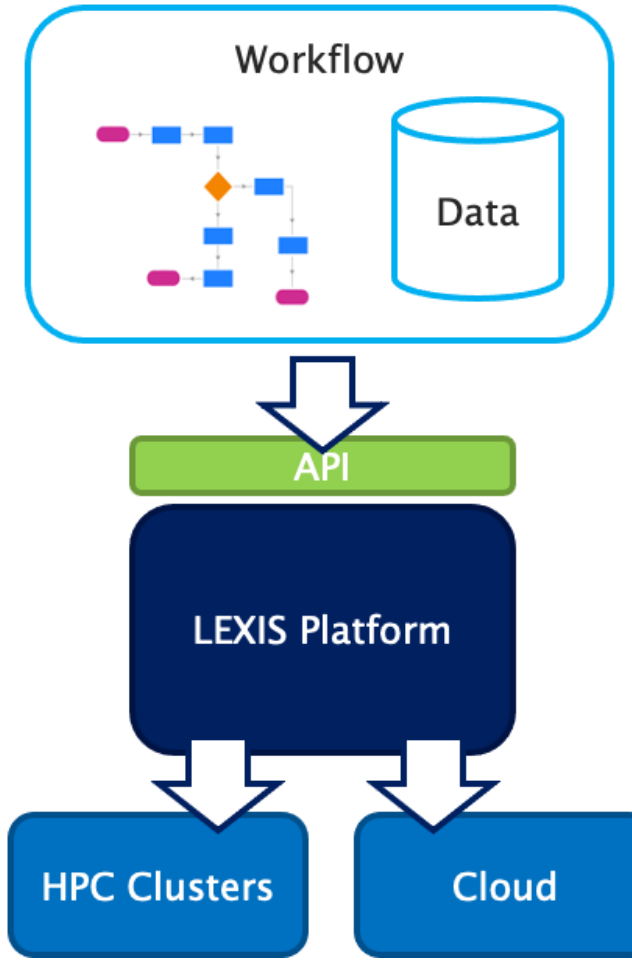
Distributed Data Management

- Parallel data transfers by iRODS, metadata index based on Elastic Search
- FAIR features enabled by EUDAT (PID generation, replication, indexing)

Web portal and interfaces for workflow set-up / execution

- Unified access to all services via OpenID-based LEXIS AAI
- Zero trust security model implemented
- Connected to B2ACCESS and MyAccessID

Open Source



FLOREON+

- Developed since 2006
- Decision support system for crisis management domain
- Floreon.eu

Hydrology

- Monitoring of hydrological situation and flood forecasting

Traffic

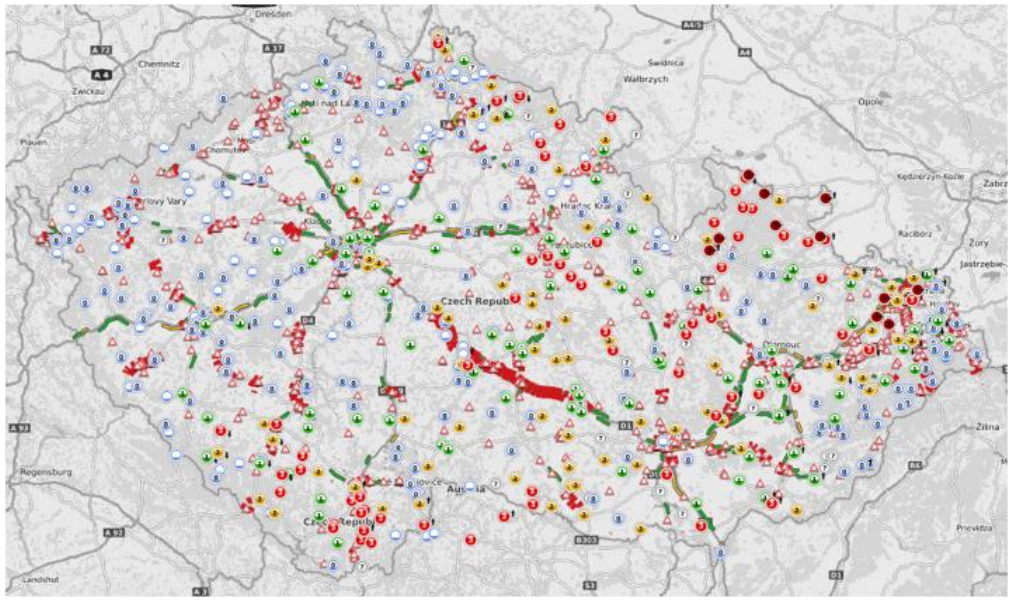
- Monitoring and modelling of traffic situation

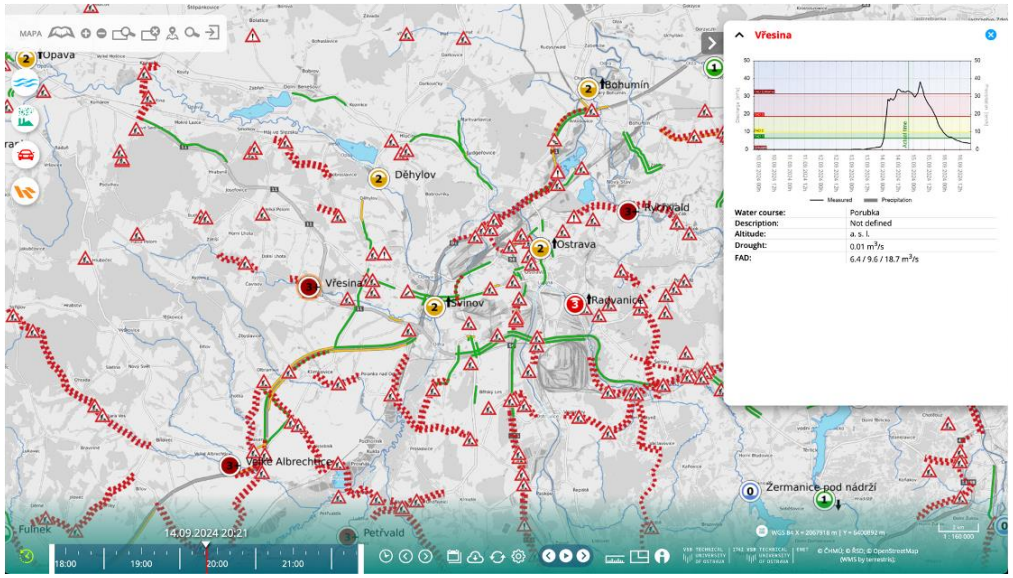
Air quality

- Monitoring of air quality and simulation of the spread of hazardous substances

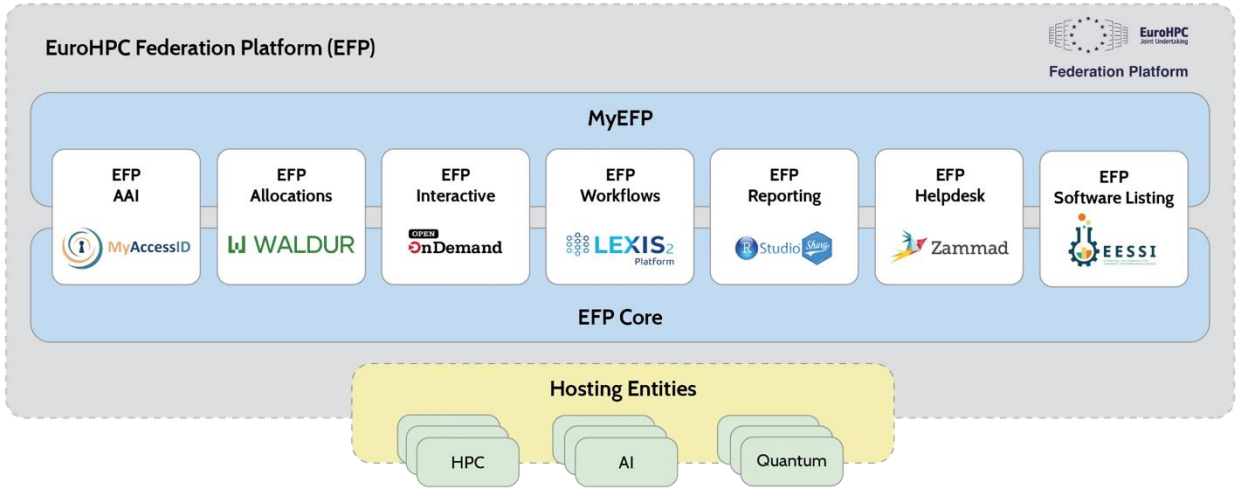
Landslides and subsidence

- Tracking of elevation point movements



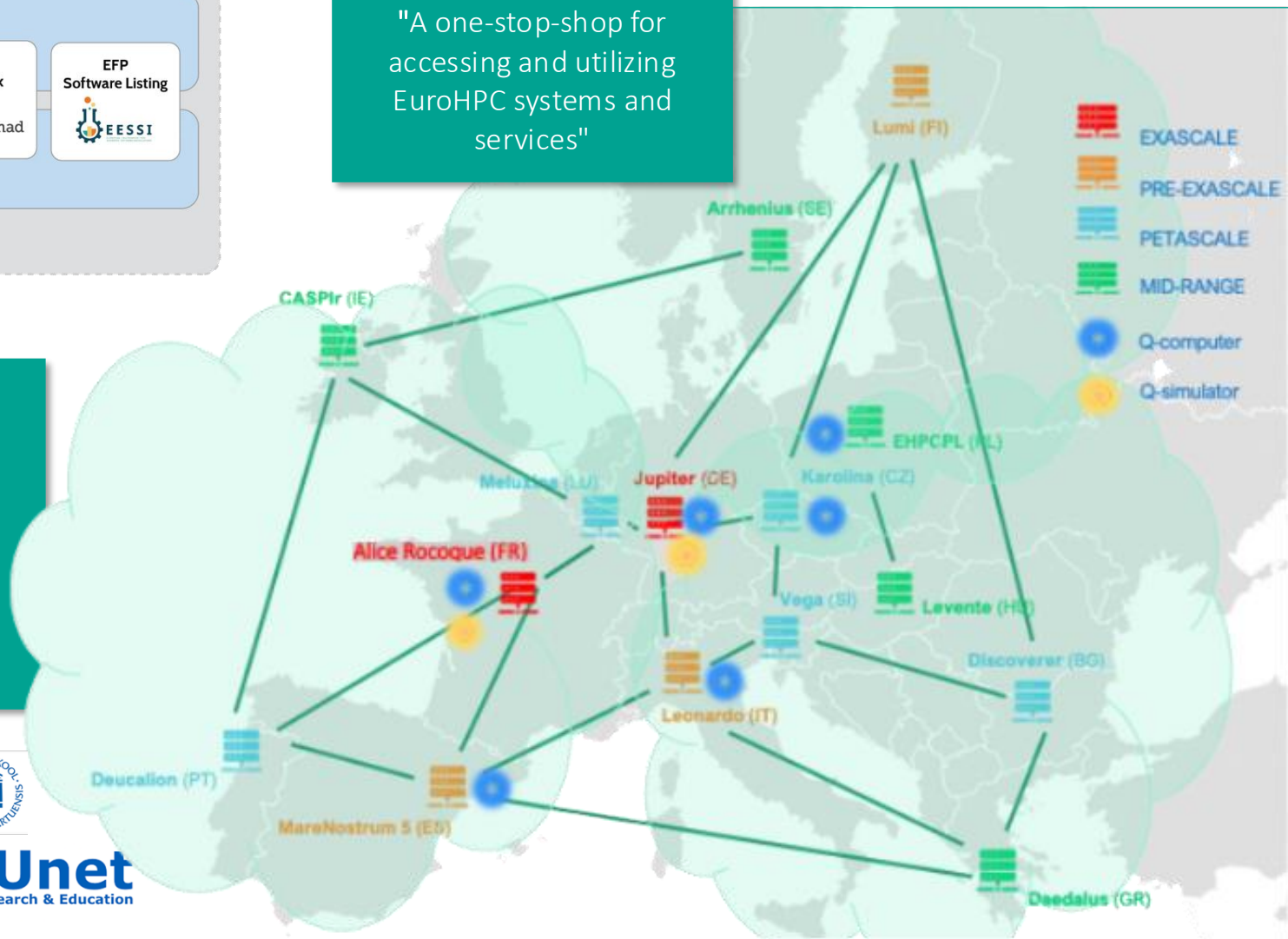


EUROHPC FEDERATION PLATFORM



- Direct access
- Interactive interfaces
- Programmatic APIs
- Unified software stack

"A one-stop-shop for accessing and utilizing EuroHPC systems and services"



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GÉANT Networks · Services · People

TARTU ÜLIKOOL 1632 UNIVERSITAS TARTUENSIS

GHENT UNIVERSITY

CSC

NORDUnet Nordic Gateway for Research & Education

QC ENERGY GRID OPTIMIZATION

Hybrid quantum optimization of a community energy network to minimize reliance on the public distribution grid.

Results obtained on the real VLQ quantum computer.

Implemented by J. Tomčala

Mathematical formulation of the problem

Each overflow can be expressed as

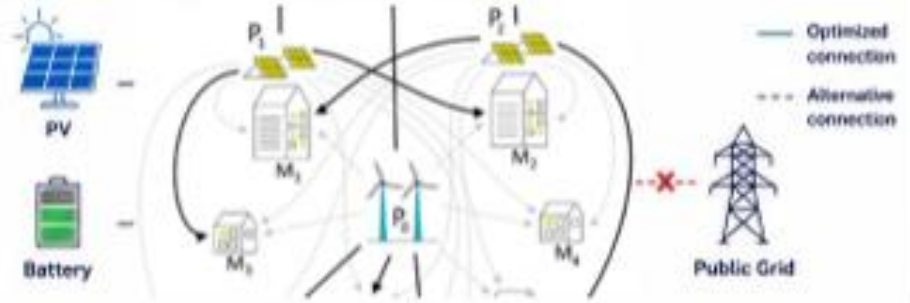
$$X_k(\mathbf{c}) = \left(\sum_{i,j} c_i M_j\right) - P_k$$

where c_i is a binary variable representing one particular connection.

Then the cost function that needs to be minimized is

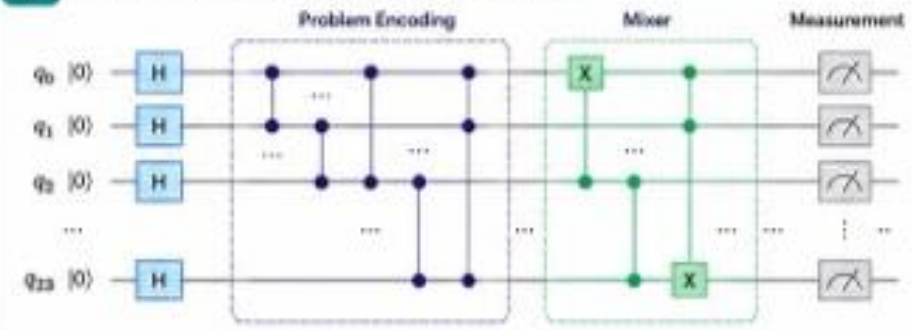
$$f_c(\mathbf{c}) = \sum_k X_k^2(\mathbf{c}) = \sum_k \left[\left(\sum_{i,j} c_i M_j\right) - P_k\right]^2$$

Schematic illustration of the optimized community energy network



Simulation output highlighting the optimal network configuration; the computation was performed on the real VLQ quantum computer.

Quantum circuit representing the algorithm



- Lower reliance on public grid
- Reduced costs and emissions
- More resilient and sustainable networks
- Real results on VLQ quantum computer

FROM ATOMS TO ALGORITHMS

CADENCE

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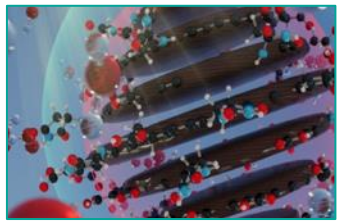
Multi-Scale AI-QC Simulation Platform – application fields

Design Single-Atom Catalysts

Engineer Carbon Nanomaterials



Model Biomolecular Systems

HPC Layer
Brings scalable computing power

Data & AI Layer
Enables data curation, model selection, agentic workflows, and FAIR data mgmt.

QC Layer
Uses QC-accelerated algorithms where classical chemistry reaches its limits

The Related Pipeline

The simulation generates a prediction, AI helps prioritise candidates, the experiment provides validation, the results are stored as FAIR data, and the results also improve the following modelling.

INDUSTRY COLLABORATION

VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

EURO CZECHIA

EDIH OSTRAVA

Czech AI Factory

LUMI AI Factory

BORCAD CZ s.r.o.

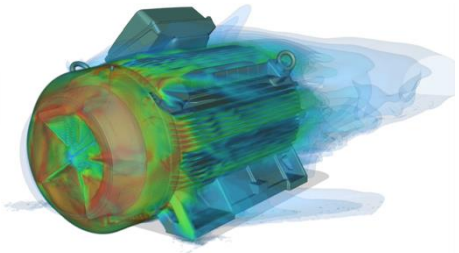
Design of passenger train seats

Ullmanna s.r.o.

Weed detection – weeding machine

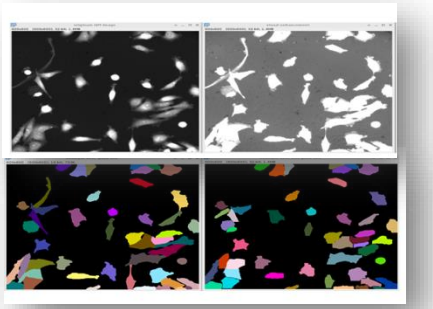
SIEMENS

Fan section optimization in asynchronous electric motors



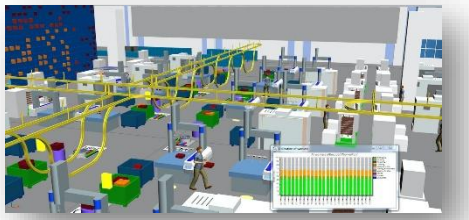
Telight s.r.o.

AI and a supercomputer have enabled to enhance the accuracy of cell analysis



NC Line a.s.

Production planning for better profitability and competitiveness



MoraviaLab s.r.o.

Smart technology helps grow microgreens

OTHER PARTNERS

NC LINE

IMPAERIA GLOBAL

esa

T-Mobile

POLICIE ČESKÉ REPUBLIKY

Lenzing
Innovative by nature

invelt group

Fraunhofer

inwiro testing & engineering

Continental

Janssen Pharmaceutical Companies of Johnson & Johnson

GS GLASS SERVICE

telight

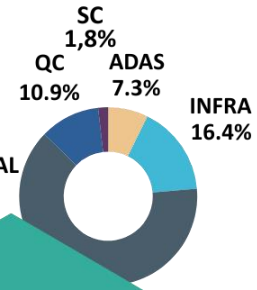
REMANTE

FAKULTNÍ NEMOCNICE OSTRAVA

DEVINN

TRAINING ACTIVITIES

VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

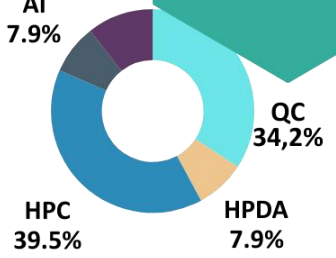


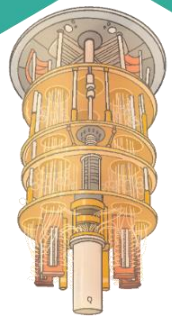
23 participants/event

Events 38

Participants 886

Tutors 55





9% from IT4I

23% from industry

47% foreign affiliation

EOSC-CZ
16 training events
1 conference

HPC TRAIN

EUMaster4HPC

SUPERHEROES 4SCIENCE

EVITA
EuroHPC Virtual Training Academy

JOINT PROJECT ACTIVITIES AND PARTNERSHIPS

VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

Research & Development

AVITH RAPID PROJECT

Falcon

Clara

InnovFuite SLOVAKIA

DTO-BioFlow
Integration of biodiversity monitoring data into the Digital Twin Ocean

TerraDT
Digital Twin of Earth system for Cryosphere, Land surface and related interactions

SPACE

MAX DRIVING THE EXASCALE TRANSITION

Partnership

BDV BIG DATA VALUE ASSOCIATION

eosc

VI-HPS

PRACE

ETP4HPC

WHPC WOMEN IN HIGH PERFORMANCE COMPUTING

e-INFRA CZ

QUIC European Quantum Industry Consortium

iRODS

I4MS

EUDAT

EuroHPC Joint Undertaking

Infrastructure development

CZAI Czech AI Factory

LUMI-Q

LUMI

LUMI AI Factory

dare

Czech Quantum Communication Infrastructure

EuroQHPC-I

POP

EUPEX

SEANERGYS ENERGY EFFICIENT EXASCALE

EPICURE Unlocking European-level HPC Support

Support to industry

LUMI AI Factory

CZAI Czech AI Factory

EDIH OSTRAVA

EURO CZECHIA

VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

Tomáš Kozubek

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IT4Innovations National Supercomputing Center
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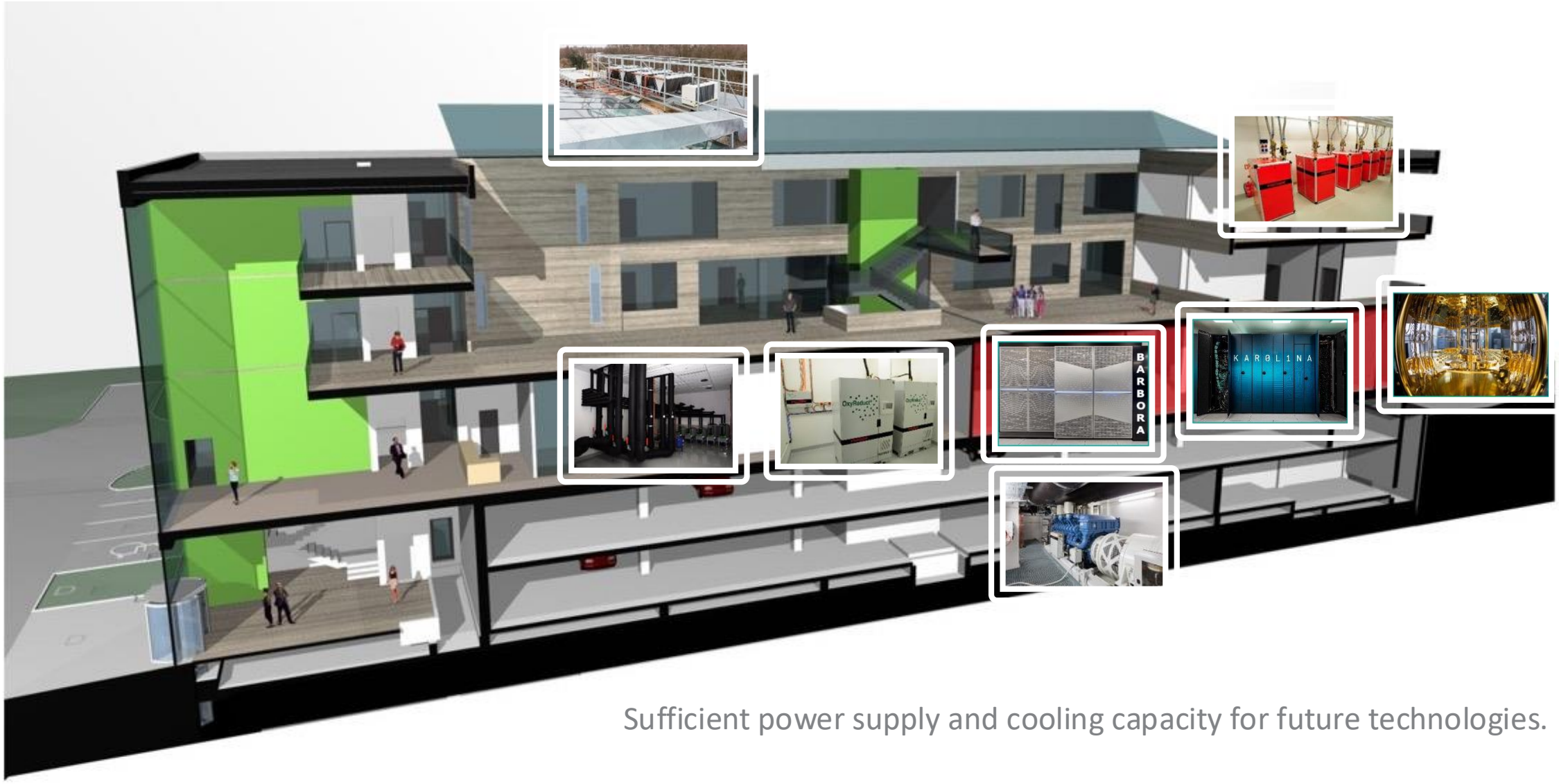
Studentská 6231/1B
708 00 Ostrava-Poruba, Czech Republic
www.it4i.eu

GUIDED TOUR OF SC, QC, AND SUPPORTING INFRASTRUCTURE



Sufficient power supply and cooling capacity for future technologies.

DRUPS BACKUP POWER SUPPLIES

Dynamic UPS

(Diesel Rotary Uninterruptible Power Supply systems)
2 x 2,5 MVA

Diesel engine

Number of cylinders: 20
Cylinder capacity: 95 l
Power: 2 390 HP
Maximum consumption: 579 l/h
Cooling: water

OXY-REDUCT

Fire safety in the data hall

Stably maintained oxygen concentration in the data hall: 15.0-15.2%

Nitrogen production per unit:

- 26 m3/h
- 95% purity of nitrogen produced
- electrical input 12.5 kW

SUPERCOMPUTER COOLING SYSTEM

Supercomputer cooling - water
Cooling circuits

Warm circuit: 2x

Temperature range: 15 to 80 degrees celsius
Cooling power, max. Circuit: 600 kw
Medium: 35% water-glycol mixture

Cold circuit: 3x

Temperature range: 6–15 degrees celsius
Cooling capacity, max (circuit): 800 kw
Medium: 35% water-glycol mixture

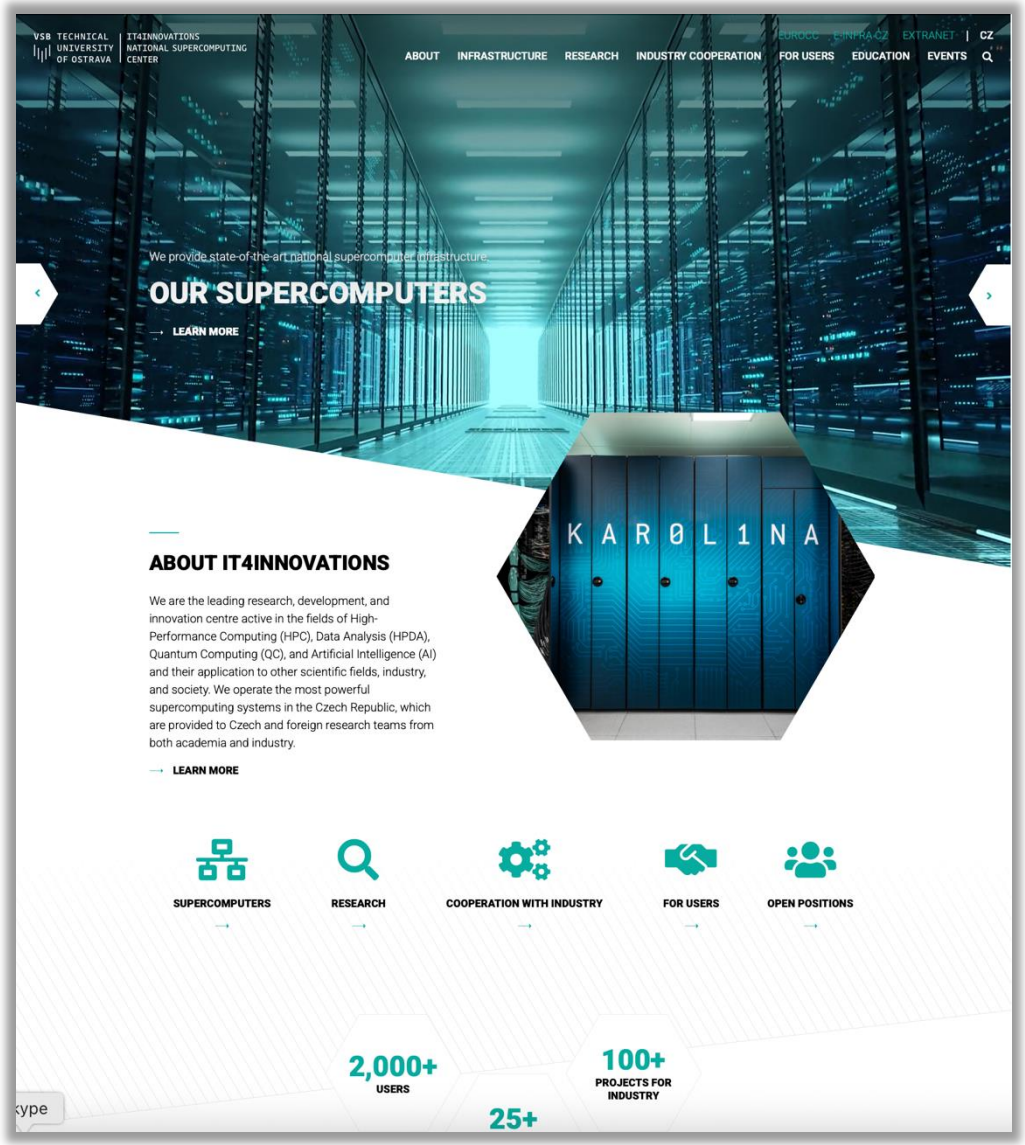
HEAT RECOVERY

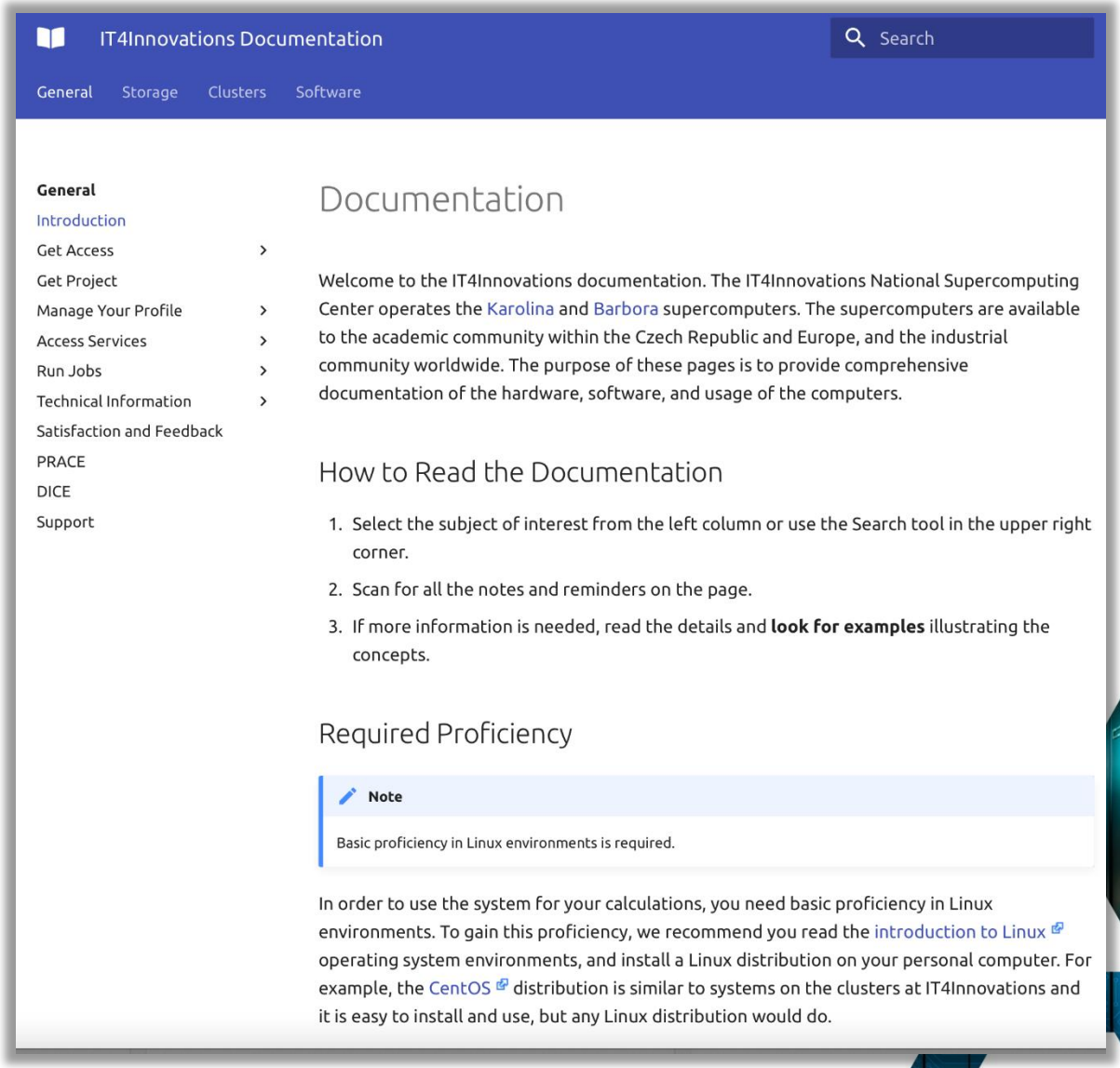
Harnessing low-temperature heat from a supercomputer

Water heating for DHW and DHW

Heat pump (chp): 5 pcs
Heating capacity of CHP: 90 kw
Electrical input of the CHP: 18 kw
Output water temperature: 60 degrees celsius
Refrigerant: R134A

WEB IT4I.CZ AND DOCS.IT4I.CZ





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