ICSC: Building Italy's National Platform for HPC, Big Data and Quantum Computing

HPC Advisory Council Switzerland
Locarno, 21-23 April 2026

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The Origins (2022): The NRRP† Vision

† NRRP: The Italian National Recovery and Resilience Plan

As part of the **Italian National Recovery and Resilience Plan**, the Ministry of University and Research in 2022 funded with €320M the constitution of the

National Research Center on HPC, Big Data and Quantum Computing (in short, ICSC)

The Ministerial main goal was to sustain research so that **innovative, low TRL research outputs may be brought to a ready-to-market state**, through direct involvement of public and private institutions:

From Research to Business

ICSC: The Hub & Spoke Model

A national ecosystem

- **50+ private and public partners** from academia, research and industry
- **ICSC Foundation** acts as the national coordinating *Hub*

Thematic areas and infrastructure

- **10 thematic *spokes*** covering key domains *(e.g. medicine, digital society, engineering, space, quantum)*
- **1 infrastructural *spoke*** providing shared compute, data and platform services

HPC, Cloud and Quantum infrastructure

- Supercomputers, high-performance and cloud data centers
- Quantum platforms and edge resources
- Connected through high-capacity national networks

European dimension

- Coordination of the **Italian EOSC node**
- Active role in **European research and digital infrastructure initiatives**

ICSC Members

National Research Institutes

12 Research Institutes

INFN · CINECA · ENEA · Consiglio Nazionale delle Ricerche · INAF · Consortium GARR

HUB

UNIMORE · Università di Parma · OGS

TODAY

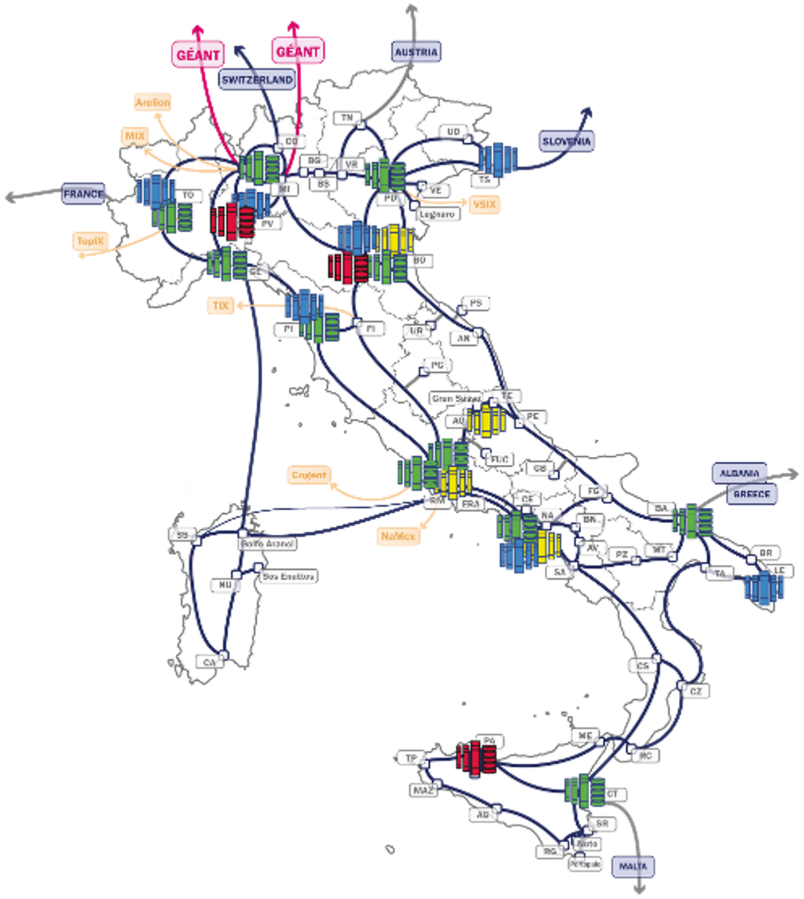
Private partners

14 Private Companies

ENGINEERING · eni · Ferrovie dello Stato Italiane · Fincantieri · fondazione innovazione urbana · autostrade per l'italia · Humanitas Research Hospital · iFAB · Intesa Sanpaolo · Leonardo · sogei · ThalesAlenia Space · Terna Driving Energy · UnipolSai Assicurazioni

25 Universities

Resources and Spokes



1 FUTURE HPC & BIG DATA

2 FUNDAMENTAL RESEARCH & SPACE ECONOMY

3 ASTROPHYSICS & COSMOS OBSERVATIONS

4 EARTH & CLIMATE

5 ENVIRONMENT & NATURAL DISASTERS

6 MULTISCALE MODELING & ENGINEERING APPLICATIONS

7 MATERIALS & MOLECULAR SCIENCES

8 IN-SILICO MEDICINE & OMICS DATA

9 DIGITAL SOCIETY & SMART CITIES

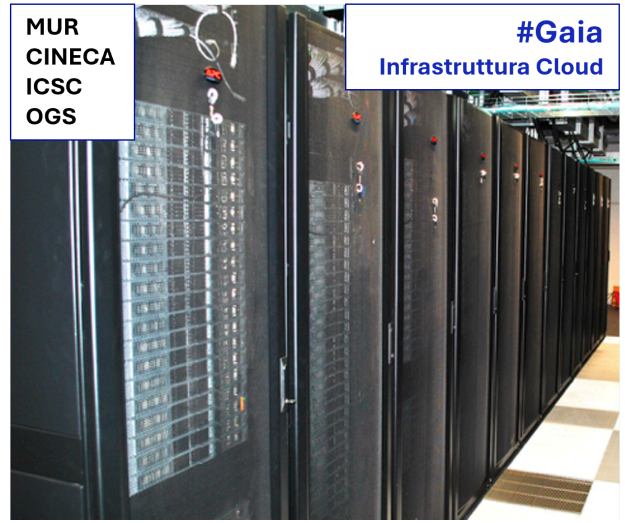
10 QUANTUM COMPUTING

+

SII
SOCIETAL IMPLICATIONS AND IMPACT

Resource Allocation

Resources are shared among all ICSC participants through a dedicated **Resource Allocation Committee** and include HPC, Cloud and (**new**) Quantum resources, as well as training and consultancy services.

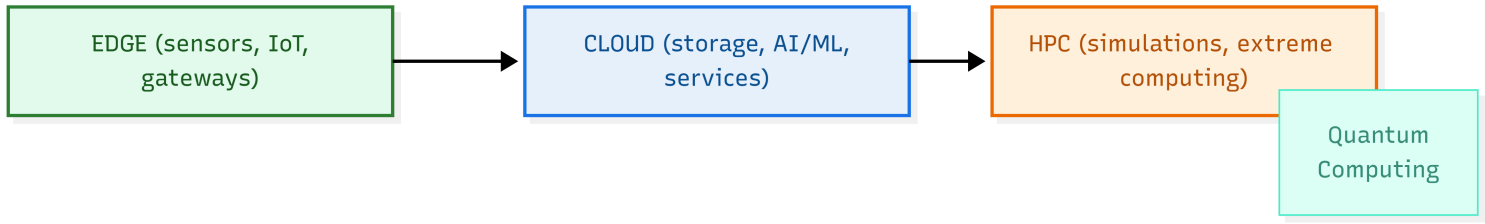


From Edge to HPC, through Applications

So far, the National Centre has primarily focused on HPC — for example, the *Leonardo* supercomputer at CINECA — **and on Cloud infrastructures**, such as the INFN data centers.

A new strategic focus for ICSC is the **Edge-to-HPC continuum**: the capability to seamlessly move data, models, and applications from the edge (e.g., sensors collecting data), through the Cloud and, when required, up to supercomputers.

However, this continuum can only function effectively if it is **underpinned by dedicated services for portability, compliance, governance, and orchestration**, together with the corresponding **applications**.



Why this shift?

- For us, the **convergence of AI, HPC, Cloud, Edge, and Quantum technologies** is not an abstract trend, but the **result of explicit strategic choices** made to ensure long-term sustainability of ICSC.
- Why does convergence matter?
  - **AI workloads** require massive compute → **HPC** provides scale and performance.
  - **Cloud** enables elasticity and automation, orchestrating workflows across HPC, Edge, and Quantum resources.
  - **Edge** supports low-latency, real-time AI inference, which is essential as data is increasingly generated at the edge.
  - **Quantum** holds the potential for disruptive advances in optimization and simulation.
- To effectively address this shift, **education and skill systems** must also evolve including reskilling and upskilling programs initiatives.

Key Challenges & Opportunities

Converged computing ecosystems bring **structural challenges and strategic opportunities**:

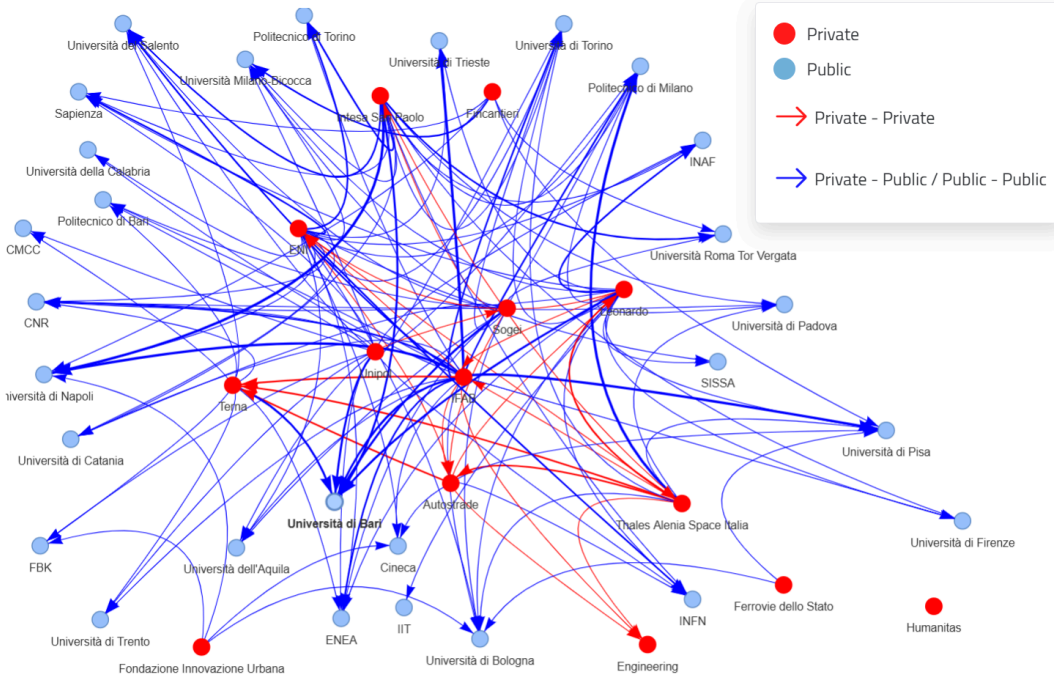
- Balancing **compute scale, energy efficiency and digital sovereignty**
- Integrating **HPC, AI, Quantum, Edge and Cloud** into usable, federated platforms
- Navigating evolving **regulatory frameworks** (AI Act, Data Act)
- Ensuring **skills availability** and effective **industry adoption**

From NRRP to a Permanent Platform

The NRRP has been for ICSC and for Italy a **foundational investment**, enabling:

- Infrastructures
- Skills
- Ecosystem building and coordination

On the right, the network resulting from over **70 funded Innovation Projects**, each led by an ICSC private affiliate.



What comes next is not another project. ICSC is transitioning from a time-limited program to a **permanent national and European platform.**

Financial and Institutional Continuity

This transition is supported by concrete financial and institutional mechanisms.

- **2027–2028 funding already allocated** through the Italian Budget Law 2025
- A **provisional 2026–2028 budget** has been approved by the ICSC BoD, combining internal resources coming from ICSC members and national funding
- Ongoing participation in **EU-level initiatives** (AI Factory, EOSC, Digital Europe, Horizon Europe, EuroHPC)

This ensures stability, continuity, and long-term planning.

The AI Factory

IT4LIA AI FACTORY

In April 2025, the Italian AI Factory project (**IT4LIA**) began. IT4LIA, run by a public-private consortium, is co-funded by EU and Italy with:

- €400M for a **new Exascale-class supercomputer** specialized in Artificial Intelligence
- €30M for the **development of AI services and applications** for research, public administrations, and industry

The ICSC Foundation leads the IT4LIA WPs on Data Services and on Training. IT4LIA is one of the steps we are taking toward the **constitution of future EU Giga Factories**.

European Open Science Cloud

In 2025, the ICSC Foundation was designated as the coordinating entity of the EOSC Italian National Node.

- The EOSC National Node is a **unique strategic asset** for Italy and for the international community, supporting Open Science and EOSC
- The services provided by the Italian node are meant to provide **tools, experience, data and support** to allow researchers to extract value from data in different research domains
  - We have currently identified 2 main use cases for the Italian Node: with **BBMRI** (on sensitive data processing), and with **CERN** (on reproducible workflow management).

Through the EOSC National Node, **we aim to participate in major upcoming EU opportunities** (WP 2026–2027). **We look forward to collaborating with interested organizations** specifically on **European calls and EOSC-related initiatives.**

ECHO-TWIN

ECHO-TWIN

ECHO-TWIN (**E**dge-**C**loud-**H**PC **O**ptimized **T**wins based on **W**orkflow-enhanced **I**nference **N**etworks) is a €15M national initiative building on the ICSC NRRP investments to create a coherent platform across the **Edge–Cloud–HPC continuum**.

The initiative is structured around three tightly interconnected projects:

- **ECHO-TWIN-RISE** (**R**esearch and **I**nnovation for **S**calable **E**dge-computing) → methods, models and algorithms for intelligent digital-twin ecosystems.
- **ECHO-TWIN-NET** (**N**etworking for **E**xcellence and **T**echnology transfer) → distributed labs and digital-twin deployment across the continuum.
- **ECHO-TWIN-UP** (**U**pskilling for **P**rogress) → upskilling and technology adoption for Italian companies.

ECHO-TWIN also addresses low-power and sovereign computing platforms (e.g. **RISC-V**) and **fosters joint activities with organizations interested in this area**.

INNOVATE

INNOVATE is the first industrial-grade supercomputer project, co-funded by the **EuroHPC Joint Undertaking** and by Italian private entities (including the **ICSC Foundation**).

- Dedicated to industrial applications
- Installation at the **Bologna Technopole** in the first half of 2027

PRESS RELEASE | 4 December 2024 | European High-Performance Computing Joint Undertaking | 2 min read

The Innovate Consortium Chosen to Host EuroHPC's First Industrial Supercomputer

The Innovate consortium, led by CINECA and including seven Italian industrial partners from diverse sectors, has been selected to host and operate the first EuroHPC industrial-grade supercomputer in Bologna, Italy.

ICSC represents the INNOVATE industrial partners towards the EuroHPC JU for **joint procurement and project execution**.

Education and Skills

Long-term sustainability requires a rethink of education and training.

Curricula must evolve

- Interdisciplinary programs across AI, HPC, Cloud, Edge and Quantum
- **Hybrid skill profiles**: scientific foundations + computing at scale

Competency frameworks must adapt

- AI–HPC integration and orchestration
- Quantum programming and hybrid workflows
- Edge AI: real-time inference and federation

ICSC is building a comprehensive training portfolio focused on the effective use of its infrastructures, and **supports joint developments and exchange of competencies and training modules** with interested organizations.

Opening the Ecosystem

To sustain growth beyond NRRP, ICSC is **structurally opening its ecosystem** through new institutional and collaborative instruments:

- **ICSC Grants**: competitive calls **reserved to ICSC members**, supporting new research and innovation activities
- **Expanded participation** in the National Center, with new membership categories and a more differentiated fee structure
- **Memoranda of Understanding (MoUs)**, enabling **long-term strategic collaboration** with national and **international partners**

ICSC invites interested organizations to explore MoUs as a framework for sustained cooperation beyond individual projects.

What Makes ICSC Different?

Several elements **clearly set ICSC apart** from other Italian or European initiative.

A One-Stop-Shop for Projects and Resources

- With the NRRP phase completed, we are broadening our membership base
- Expanding our focus **from projects to services**
- Extending our reach into **national and EU programmes**
- Enabling **horizontal integration** through a unified Service Catalog
- Addressing training programs for both research and industry

Conclusion

The **National Center on HPC, Big Data and Quantum Computing**, established in 2022 through NRRP funding, has rapidly become a **national and international reference ecosystem** for multi-disciplinary science, applied AI, state-of-the-art infrastructures, technology transfer, and industry engagement.

With the conclusion of the NRRP phase, ICSC is entering a new phase of operation as a **permanent national and European platform**.

ICSC is open to exploring **new MoUs, new memberships, and strategic collaborations** on upcoming Italian and European initiatives.

For further information: visit the ICSC website or contact me at davide@supercomputing-icsc.it.