CHPC NATIONAL CONFERENCE 2025

NICIS 4-Year Business Plan Overview

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A national initiative of the Department of Science, Technology and Innovation and implemented by the CSIR

science, technology & innovation
Department:
Science, Technology and Innovation
REPUBLIC OF SOUTH AFRICA

CSIR
Touching lives through innovation

Proposed BP Timeliness

- Engagements with DSTI: Ongoing
- Draft BP shared with CHPC staff
- Engagement with CHPC user community
- Consolidate user community input into the draft BP
- Submission of CHPC BP for NICIS consolidation into NICIS BP
- Consolidated NICIS BP submission to DSTI
- Approved NICIS BP ready for implementation: 1 April 2026 – 31 March 2030

Structure of the Business Plan

- Environmental scan informing the plan
- Benchmarking with similar organizations around the world
- Current Status of NICIS Infrastructure and Services
- Proposed growth areas

Key Performance Indicators

- Infrastructure availability and utilisation
- Impact – Research enablement and differentiating capabilities
- Human Capital Development – Addressing the triple challenges (Poverty, Inequality and Unemployment)
- Enabling the Capable State
- Driving the industry competitiveness

Disruptive Trends and Newly Emerging Landscape

Disruptive Trends in Scientific Practice

- The global research landscape has undergone a profound transformation, reshaping how knowledge is produced and applied.
- **Wave 1 - From Analogue to Digital**
  - Traditional analogue instruments such as microscopes, telescopes, and calculators were once the foundation of scientific practice.
  - These tools have been progressively replaced by digital research infrastructure, where computing platforms and information systems perform calculations, process data, and simulate real-world phenomena at unprecedented speed and scale.
- **Wave 2 - From Digital to AI-Enhanced Discovery**
  - Today, the research process is increasingly AI-assisted, with machine learning, deep learning, and natural language models driving automation, prediction, and decision-making.
  - AI is not just a tool but a collaborator in research, influencing new knowledge practices across health, climate, energy and genomics ect.

Disruptive Trends in Scientific Practice

- **Wave 3 - Towards Quantum-Enabled Science**
  - Looking ahead, Quantum Computing represents the next frontier.
  - **By harnessing the principles of superposition and entanglement, quantum technologies offer capabilities and possibilities that far surpass those of classical HPC.**
  - **They aim to transform fields such as cryptography, financial modelling, materials science, and drug discovery, enabling researchers to address problems once considered challenging.**
- This progression from analogue tools, digital research infrastructure, AI-enabled discovery, and Quantum-enabled science illustrates the evolving foundation of global research and innovation.
- **For South Africa and the continent of Africa, early involvement in this path is not optional but crucial to achieve socio-economic impacts in a world that is increasingly driven by technology.**

The Emergent Landscape Facing CHPC

- **Technological Convergence**
  - Workloads are becoming more hybrid, blending traditional simulations with AI/ML and data analytics. We are preparing to support GPUs, AI accelerators, Quantum Computing Services, and cloud-native orchestration, in addition to conventional HPC systems.
  - Quantum technologies are emerging as complements rather than replacements for HPC. We are preparing for integration opportunities of quantum simulators.
  - Edge-to-HPC pipelines: With IoT and 5G, massive data flows from the edge (health, climate, agriculture, astronomy) require new data pipelines and HPC for analysis.

The Emergent Landscape Facing CHPC

- **Data-Centric Science & Infrastructure**
  - The data deluge: From telescopes (SKA Regional Centre), particle physics (CERN), genomics (110k genomes), and climate models, CHPC faces exponential data growth.
  - Storage + curation: Tiered storage (flash/disk/tape/object) and FAIR principles are becoming standard expectations.

The Emergent Landscape Facing CHPC

- **Sustainability Pressures**
  - CHPC is one of the largest power consumers among research facilities in South Africa. Pressure is increasing to adopt renewable energy and energy-efficient technologies and architectures.
- **Funding Challenges**
  - DSTI remains our primary funder, but should we consider third-stream income?
- **Human Capital & Skills**
  - HPC sysadmins, software engineers, data scientists, and OpenStack Cloud Engineers are in high demand, facing private sector competition.
  - AI engineers, data stewards, and quantum technologists are becoming integral to HPC facilities.
  - Due to the expertise of the CHPC staff, we train individuals in digital and computational literacy across academia, government, and industry.

– **Geopolitics**
  - We are concerned about the global supply chain disruptions.

Responding to Disruptive Trends and Newly Emerging Landscape

Wave 1: Analogue → Digital : Traditional instruments replaced by digital research infrastructure.

- Lengau cluster since **7 March 2017** (First phase June 2016)
- Africa's first Petascale system ⇒ **1.029 PFlops = 1 029 TFlops**

(121st on Top500* – June 2016)

(127th on Top 500* – June 2017)

Lengau (HPC Cluster)

- 1386 nodes
- 32 832 cores
- 30 V100 GPUs
- 56Gbps IB interconnect
- 4PB Lustre storage
- ~1Pflop/s HPL

Deployed in 2016/17
Debut at 121 on Top500

Special Nodes

- 5 High memory nodes
- 30 GPU nodes

Wave 1: Analogue → Digital : Traditional instruments replaced by digital research infrastructure

PROJECT START DATE

July 2024 | Oct 2024 | Nov 2024 | Dec 024 | Q1 | Q3 | Q4

Data Centre Readiness

✓ Identify a DC Hosting site for DR and Scalability

System Environment Readiness

✓ Virtual Image provisioned to test workloads

Factory assembling and testing

Factory benchmarks – HPL for Top 500.

Equipment Arrival 15 Feb 2025

HPE/Intel Emerald Rapids 4PF HPC Cluster

- **512 EMR Compute Nodes with 2*8593Q 2.2GHz 64-cores 385W**
- **Compute Interconnect Network : NDR200**
- **Administration network : 10GbE**
- **Layout : 10 racks : 9*800 + 1*600 = 7,800mm**
  - 8 racks for compute nodes (800mm)
  - 1 rack for service nodes (600mm)
  - 1 rack for interconnect (800mm)
- **Estimated Utilization Power Consumption for the solution : 690KW**

Rosebank Refurbishment, ICT

Installation and Deployment

New Parallel File System RFQ and Implementation

CERN ALICE Collaboration - Provide a Tier 2 high-performance computing node for data analysis, storage, and simulation.

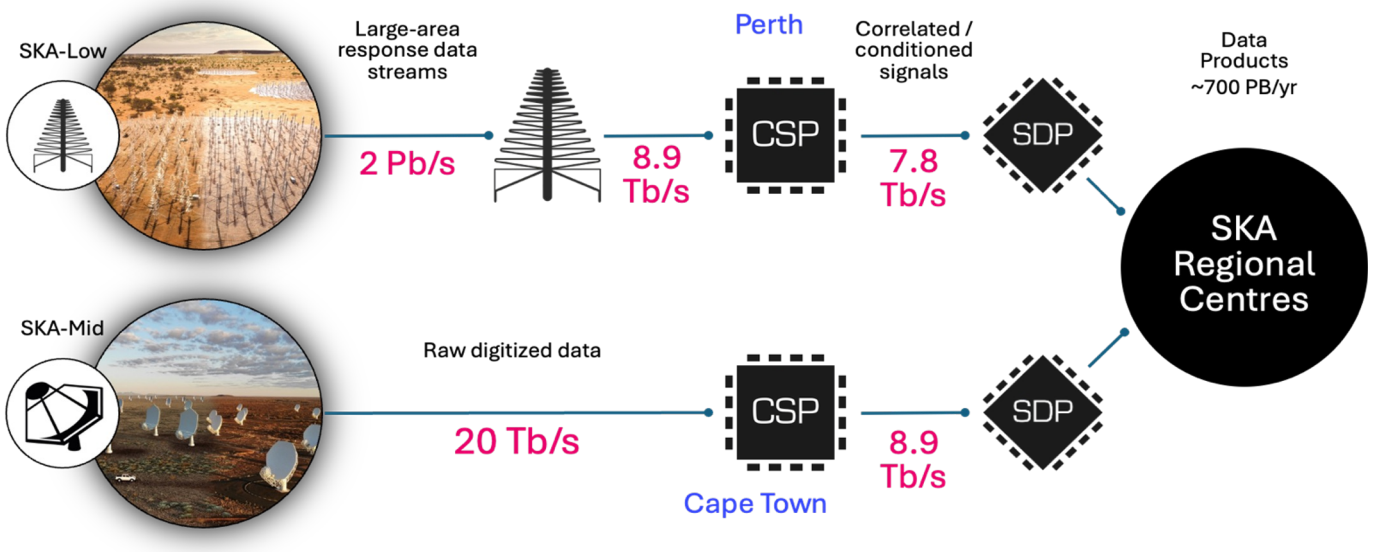
1. Worker Nodes
2. Obsolete Worker Nodes
3. Management Servers
4. EOS Storage

Purpose

- To provide computing and storage resources for the Worldwide LHC Grid (WLCG) ALICE experiment.

SKAO Collaboration: SA -SRC Regional Centre

NICIS will supply the Compute, Storage, and Networking Infrastructure for the SA-SRC.



- **Data Reception and Storage**
  - Receive science-ready data products from the SKA Observatory's Science Data Processors.
  - Store large volumes of SKA data for long-term access.
- **High-Performance Computing (HPC) & Analysis**
  - Provide computing infrastructure (HPC, cloud, AI/ML tools) to enable scientists to process, analyse, and reprocess SKA data.
- **User Access & Support**
  - Act as the primary interface between the SKA and the global scientific community.
  - Provide training, software tools, and user support for astronomers.
- **Collaboration & Science Enabling**
  - Facilitate international collaboration across astronomy, data science, and HPC.
  - Support multi-disciplinary research (e.g., astrophysics, cosmology, big data science).

110k Human Genomes Project: Health & Bioinformatics Grand Challenge

- Large-scale compute for genome sequencing, assembly, and analysis, plus secure storage for sensitive genomic data.
- Genomics projects need on-demand cloud-based access for bioinformaticians.
- Create training pipelines for bioinformatics, AI in health, and genomics data science.

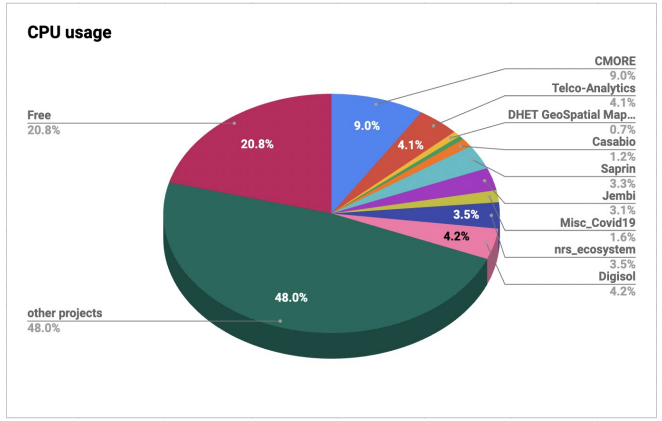
CHPC Growth Path 2026 – 2030: HPC

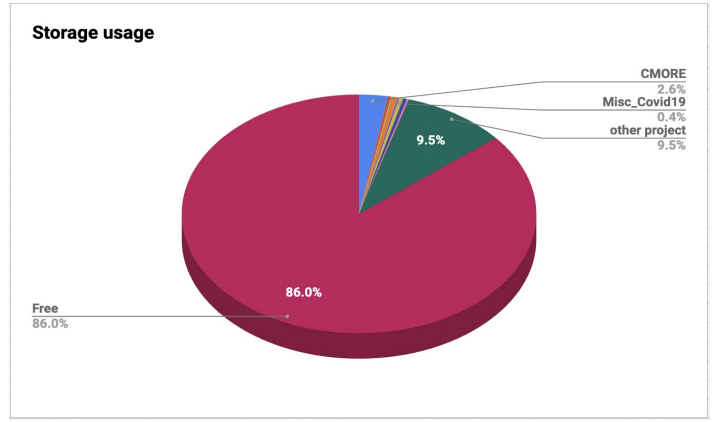
- To provide, maintain, and scale national converged research infrastructure (HPC, AI, Cloud, and Quantum Computing).
- Deepen our involvement in large-scale science collaborations (e.g., ALICE at CERN, SKA Regional Centre, 110k Human Genome Project), ensuring global relevance.
- The global HPC supply chain has become increasingly vulnerable to geopolitical tensions, trade restrictions, and component shortages develop an interoperability framework to ensure seamless integration across heterogeneous platforms, enabling continuity of service regardless of global supply chain disruptions.
- A second Data Centre facility will be identified to provide disaster recovery and redundancy, marking a strategic shift to a multi-site environment that ensures continuity and resilience for national research workloads.

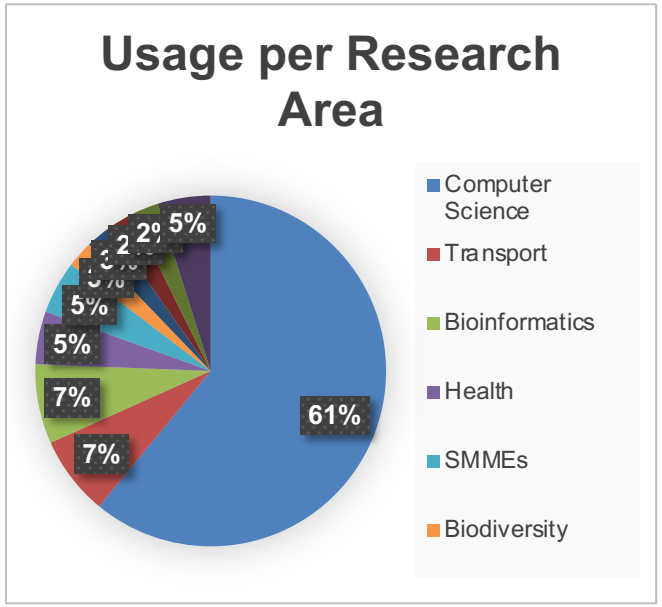
Wave 1: Analogue → Digital : Traditional instruments replaced by digital research infrastructure.

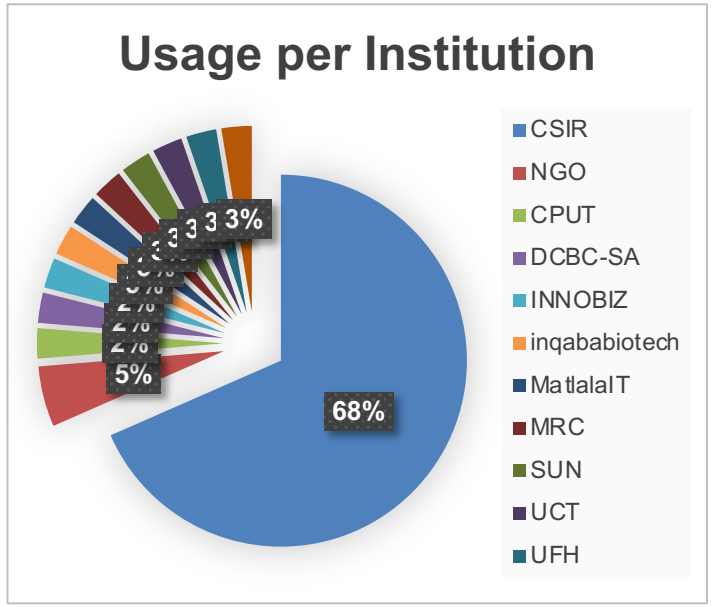
Localised Cloud Platform

- Specification
  - 2944 Cores
  - 12TB RAM
  - 2.8PB HDD Storage
  - 368TB SSD Storage
  - 60TB NVMe Storage
  - 25GbE Network
- Operations
  - In production since 2020
  - 55+ hosted projects
  - Supported by StackHPC



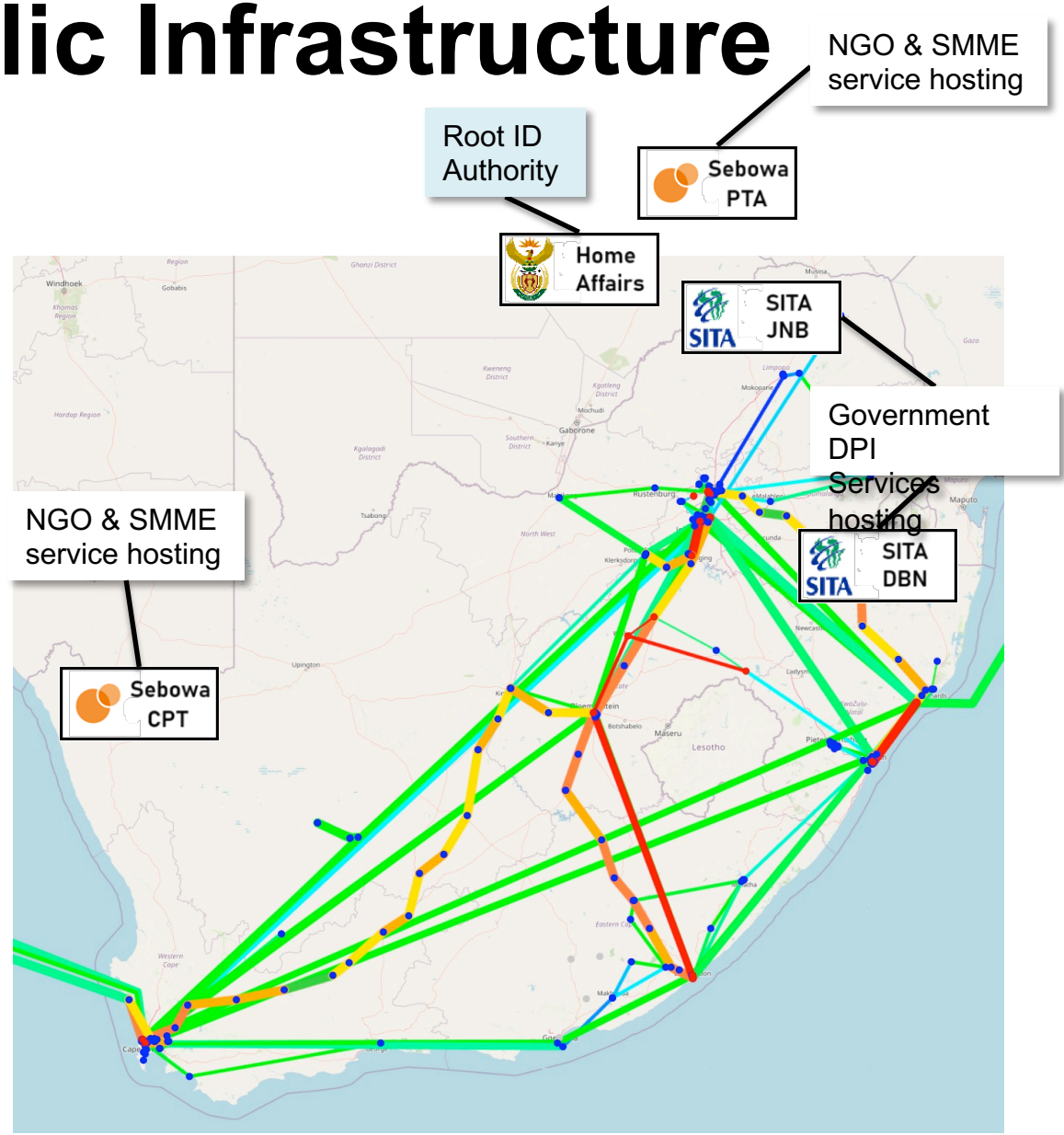






Supporting Digital Public Infrastructure

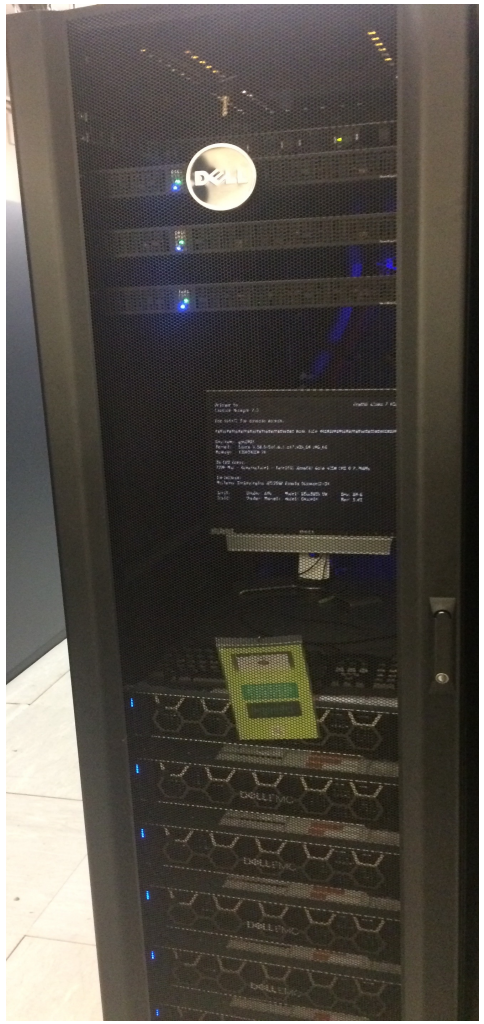
- Scalable platform based on OpenStack and CEPH
- Integrated with South Africa's cyberinfrastructure
- Localised on premises platforms
  - Single view of a person
  - Verification service
- Localised public cloud (Sebowa)
  - NGOs
  - SMMEs
- We want to collaborate
  - Common architecture
  - Customisation
  - Deployment
  - Support
  - Build cloud skills in South Africa
- Already have experience hosting DPI services
  - EVDS Portal
  - Cmore
  - MzanziXchange



CHPC Growth Path 2026 – 2030: Localised Cloud

- Our OpenStack-based NICIS Cloud Platform will expand to serve as South Africa’s sovereign Localised Government Cloud, Localised Research Cloud and Localised Industry Cloud, ensuring secure and scalable access to research, government, and industry.
- Over the course of four years, the NICIS Localised Cloud roadmap focuses on hybrid integration with AI, HPC, and Quantum to support both data-intensive science and digital government platforms

Wave 2: Digital → AI-Enhanced Discovery, Machine learning, deep learning, automation shaping new knowledge-making.



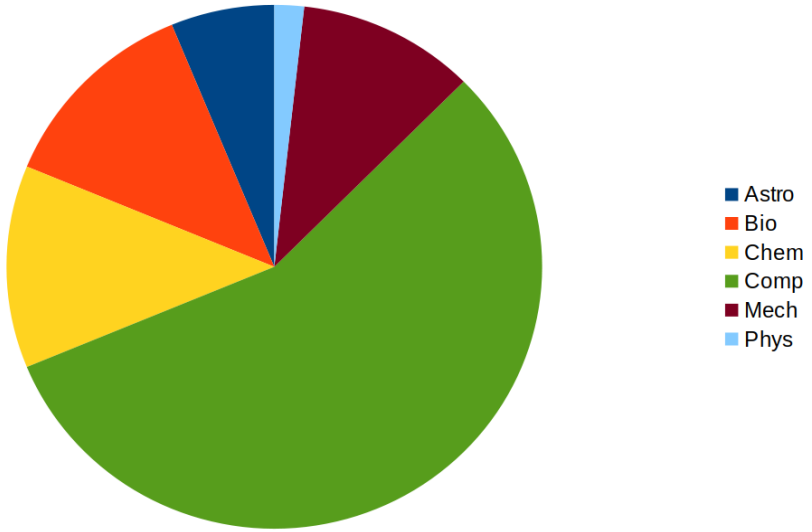
- **Graphical Processor Unit (GPU) Cluster:**

  30 NVIDIA V100's

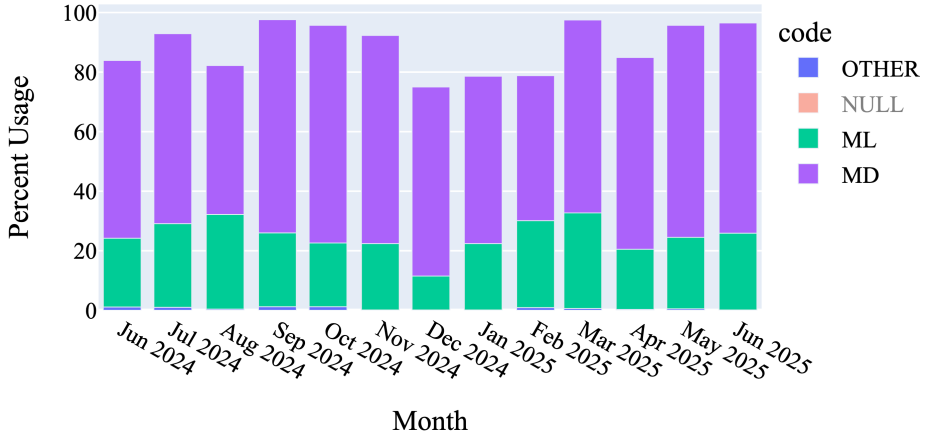
- Since **September 2018**

- Usage Demand:
  - **Transfer of Chemistry Users (MD)**
  - **Resources for Machine Learning (ML)**

Wave 2: Digital → AI-Enhanced Discovery, Machine learning, deep learning, automation shaping new knowledge-making.



Research Domains



- Deepen our involvement in large-scale science collaborations ensuring global relevance
- Grow our AI Infrastructure to support the growing demand universities, the public sector, and SMEs
- Exploring AI Infrastructure Access partners, locally and internationally

saMRC advancinglife

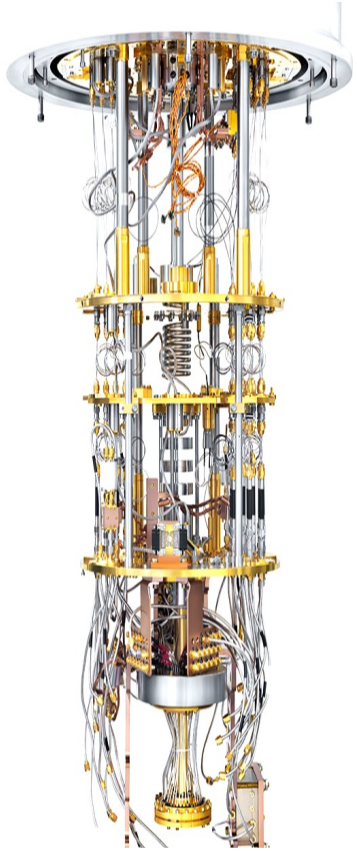
ALICE

CERN

CHPC Growth Path 2026 – 2030: A.I Infrastructure

- Grow a dedicated National AI Compute Resource (AI Infrastructure)
- Scale-up OpenStack Localise Cloud Platform and AI infrastructure to meet growing demands from government, industry and SME’s
- AI-as-a-Service: Develop containerised platforms (e.g., via OpenStack and Kubernetes) so researchers can run AI workloads efficiently without requiring deep system administration knowledge.

Wave 3: AI → Quantum-Enabled Science - Quantum computing redefining simulation, optimisation, materials & drug discovery.



- Department of Science, Innovation and Technology (DSIT) has developed a Framework for Quantum Technology-Driven Research and Innovation in South Africa.
- This framework outlines a plan for South Africa to establish a globally competitive research environment in quantum technology and grow a local quantum technology industry.
- The CHPC's role is to provide quantum computing access services, facilitate collaboration between academia and industry, and increase public awareness and understanding of quantum technology.

Quantum Computing Access Growth Path 2026 – 2030

- Unlock more value from the IBM – CSIR/CHPC Quantum COE
- Continue to procure QC access services aligned with the SAQuTI framework.
- Operate quantum simulators and cloud-based quantum access in conjunction with HPC.
- Seek collaboration partners to bridge to the global QC ecosystem (Africa, BRICS, EuroHPC and Industry alliances)
- Expand the QC expertise through internships, studentships and partnerships
- Establishing training hubs (training programs) to create a quantum-ready workforce of researchers
- Deploy the first Quantum Computer in Africa

CHPC Growth Path 2026 - 2030

Key Strategic Shifts (vs. Previous Plan)

- Technology: HPC-only → **Converged HPC-AI-Cloud-Quantum.**
- Funding: Public only → **Public + third-stream revenue.**
- Footprint: Single site → **Multi-site/distributed with DR.**
- Client base: Research-centric → **Research + Government + Industry.**
- Value: Raw compute → **Public value, digital services, and innovation.**

Mandate and Vision

- To provide, maintain, and scale a national converged research infrastructure that integrates HPC, AI, Cloud, and Quantum Computing services for the advancement of research and innovation in South Africa and the region.
- To be the continent’s leading converged research infrastructure hub that collaboratively generates impact through integrated, technology-enabled research, innovation, and services for academia, government, and industry.

Strategic Focus Areas (2026–2030)

1. Technology Convergence and Future-Ready Infrastructure
2. Paid consulting, training, and support services
3. Digital Sovereignty and Data Localisation
4. AI-Driven Science and Industry Innovation
5. To expand expertise in converged research infrastructure
6. Contribute to Large-scale Scientific collaboration and research programs

Strategic Objectives

- To provide, maintain, and scale national converged research infrastructure (HPC, AI, Cloud, and Quantum Computing).
- To enable our research community to achieve its computational research goals.
- To integrate HPC, AI, Cloud, and Quantum Computing services and facilitate next-generation applications like digital twins, ML platforms, and real-time analytics.
- To expand our services by offering paid consulting, specialised training, and technical support for industry and government (third stream) income.
- To expand expertise in converged research infrastructure.
- To promote environmentally sustainable computing practices and infrastructure design.
- To advance South Africa’s strategic contribution to global large-scale science programmes and research collaborations by leveraging national capabilities in converged research infrastructure (HPC, AI, Cloud and Quantum)

Your Inputs

Following the session, we will share the presentation along with a link for you to provide your contributions.

https://forms.cloud.microsoft/r/SjKgRLs1QA

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