

AN INITIATIVE OF:



science, technology
& innovation

Department:
Science, Technology and Innovation
REPUBLIC OF SOUTH AFRICA



CSIR | 80th
Touching lives through innovation anniversary

NICIS

NATIONAL INTEGRATED
CYBERINFRASTRUCTURE SYSTEM

Africa's Readiness to Adopt HPC, Cloud and Quantum

Dr Happy Sithole
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NICIS: National Integrated Cyber-Infrastructure System

www.nicis.ac.za

www.sanren.ac.za

**SANReN
(Networking Services)**

NICIS

NATIONAL
INTEGRATED
CYBERINFRASTRUCTURE
SYSTEM

**CHPC
(Computing Services)**

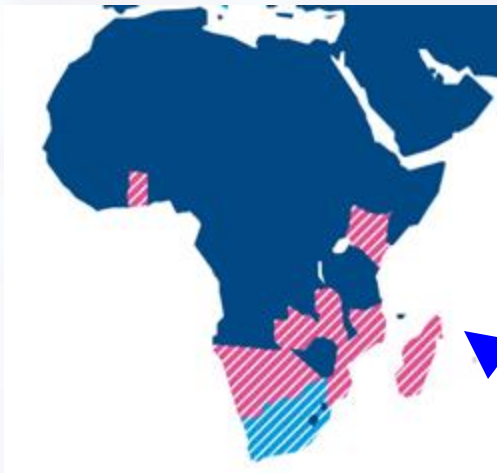
www.chpc.ac.za

**DIRISA
(Data Services)**
www.dirisa.ac.za

Centre for High Performance Computing

NATIONAL SUPERCOMPUTING FACILITY

- 4.017PF system
- Currently in installation process
- Largest HPC System in Africa



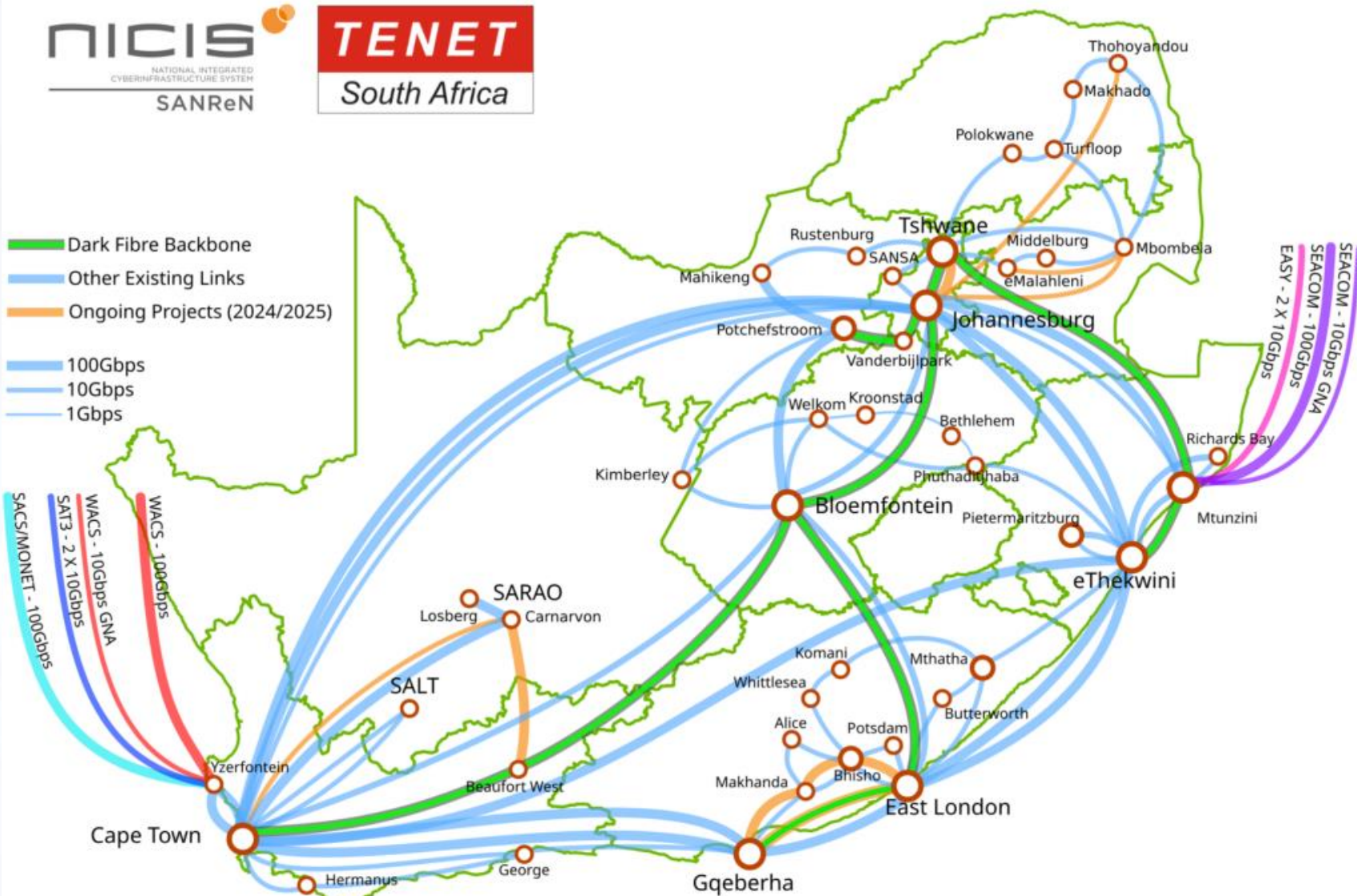
... FOR RESEARCH COMMUNITY

- South African Academic Institutions & Research Facilities
- Southern Africa Community partners
- SKA partner countries
- Failover Service for SAWS



Introduction to CHPC





Introduction to CHPC

Current Resources at the CHPC:

- ❑ Lengau cluster since **7 March 2017** (1st phase June 2016)
- ❑ Africa's 1st Petascale system \Rightarrow **1.029 PFlops = 1029 TFlops**

(121st on Top500* – Jun 2016)

(127th on Top 500* – Jun 2017)





New HPC Cluster at the CHPC

- **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**



Digital Research Infrastructure: GPU Cluster

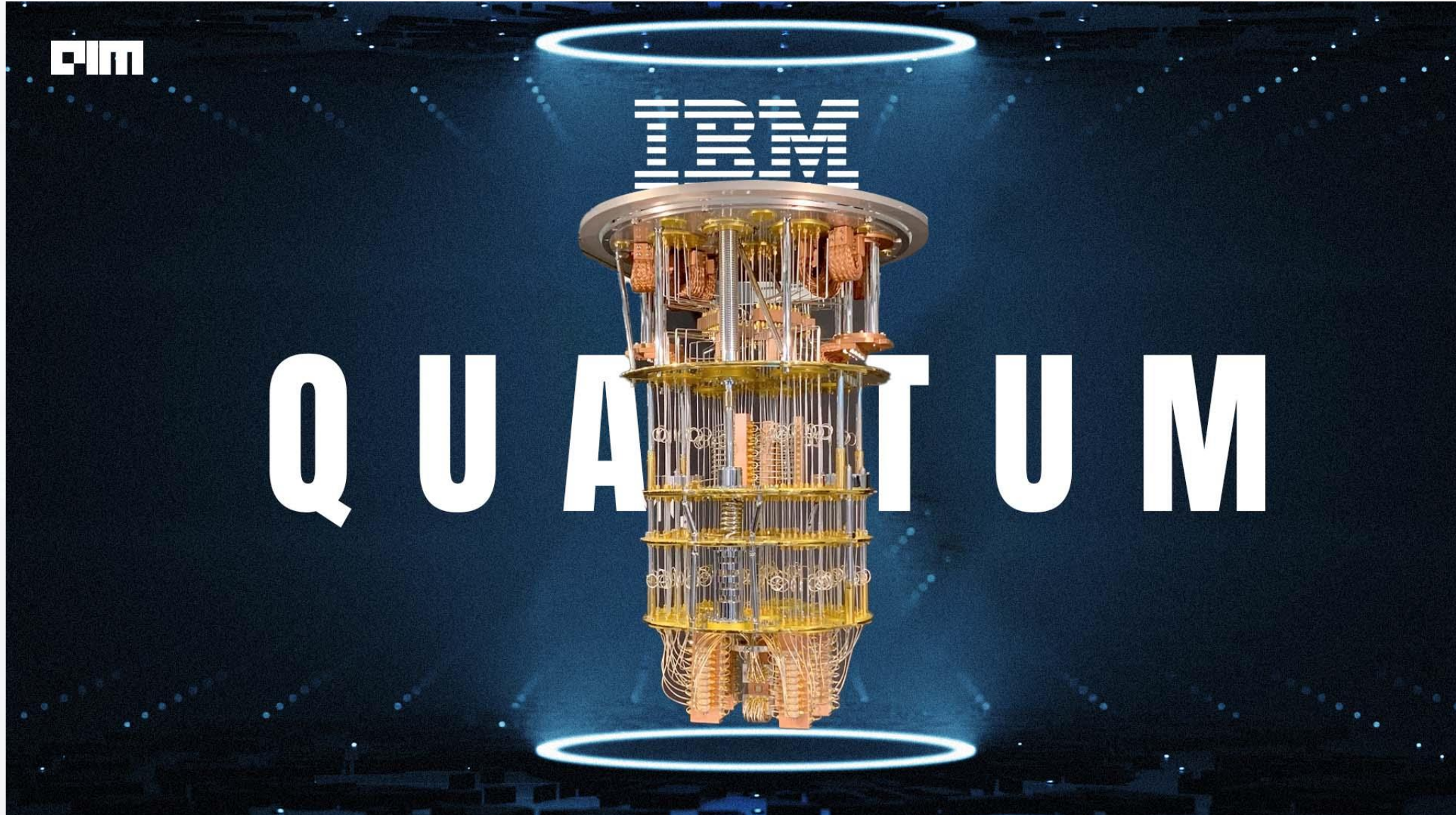
- ❑ **Graphical Processor Unit (GPU) Cluster: 30 NVIDIA V100's**
 - ❑ 6 nodes (36 Intel Gold 6150 CPU's; 2 V100's; PCIe)
 - ❑ 2 nodes (40 Intel Gold 6150 CPU's; 4 V100's; NVLink)
- ❑ Since **September 2018**
- ❑ Demand from CHPC Users for GPU Resources:
 - ❑ **Chemistry Molecular Dynamics (MD)**
 - ❑ **Resources for Machine Learning (ML)**
- ❑ Policies:
 - ❑ Dedicated GPU Queues through PBS Pro
 - ❑ gpu_1, gpu_2 and gpu_4
 - ❑ 1 GPU Hour \approx 40 CPU Core Hours (Allocation Accounting)

Details of CHPC GPU Cluster: <https://wiki.chpc.ac.za/guide:gpu>





QC Access through IBM Quantum





UK – SA Quantum Knowledge Exchange Visit



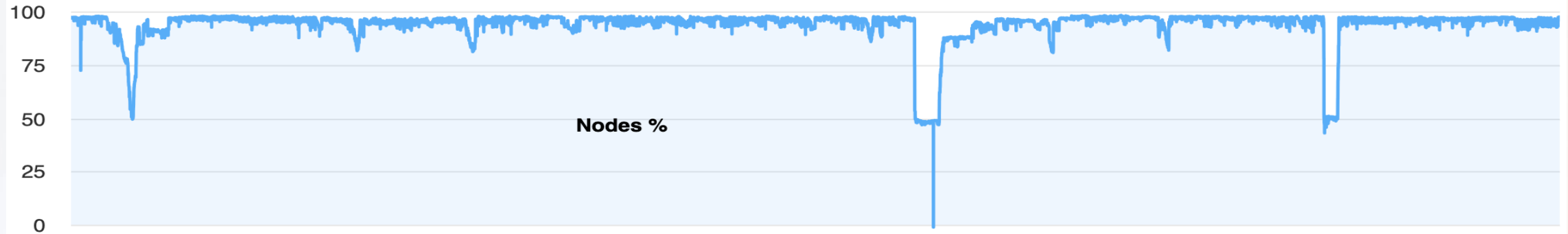
South African Delegation

- Prof. Neerish Revaprasadu (University of Zululand)
- Prof. Francesco Petruccione (Stellenbosch University)
- Dr Sagren Moodley (Department of Science, Technology and Innovation)
- Mrs Loice Alusala (Science and Technology Network of the British High Commission)
- Dr Yaseera Ismail (Stellenbosch University)
- Mr Nyameko Lisa (Center for High Performance Computing)

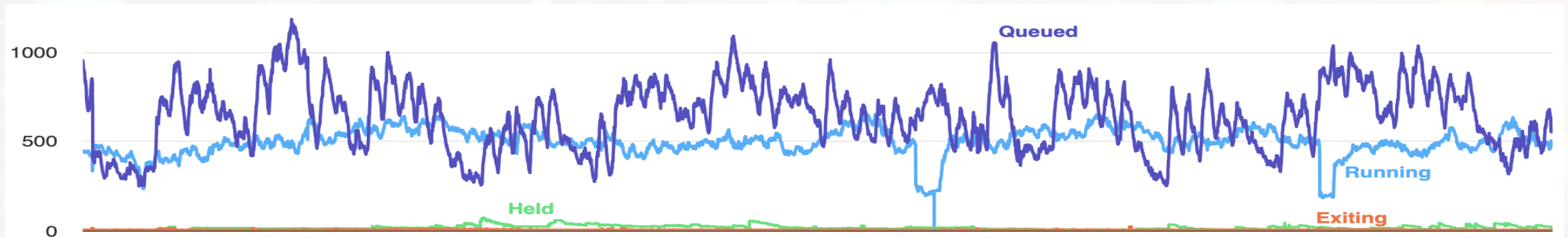


CHPC Lengau Usage : CPU Cluster

Computer Node Usage (%)

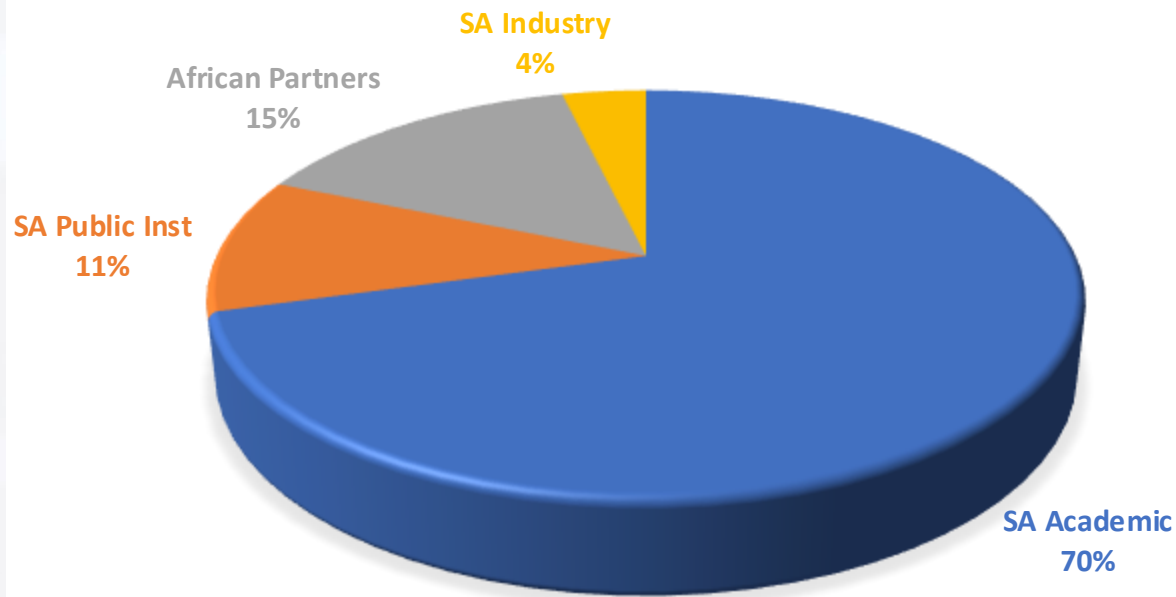


Number of Jobs



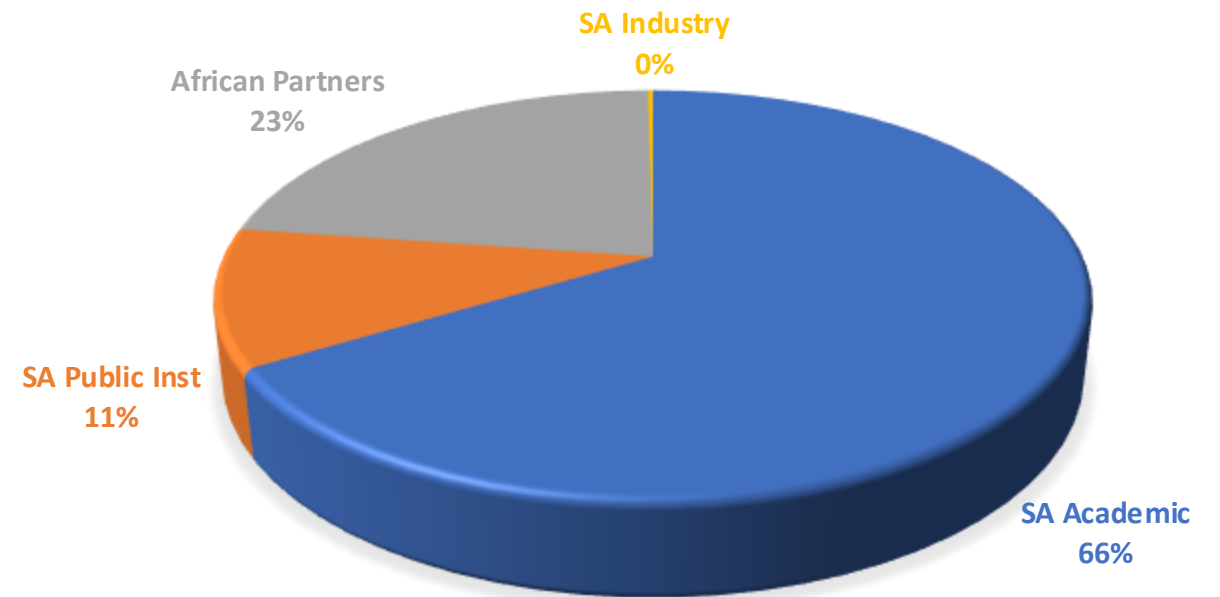


CHPC User Categories **Total Active* Programmes** Past 6 Months



Active Programmes

Total: 269

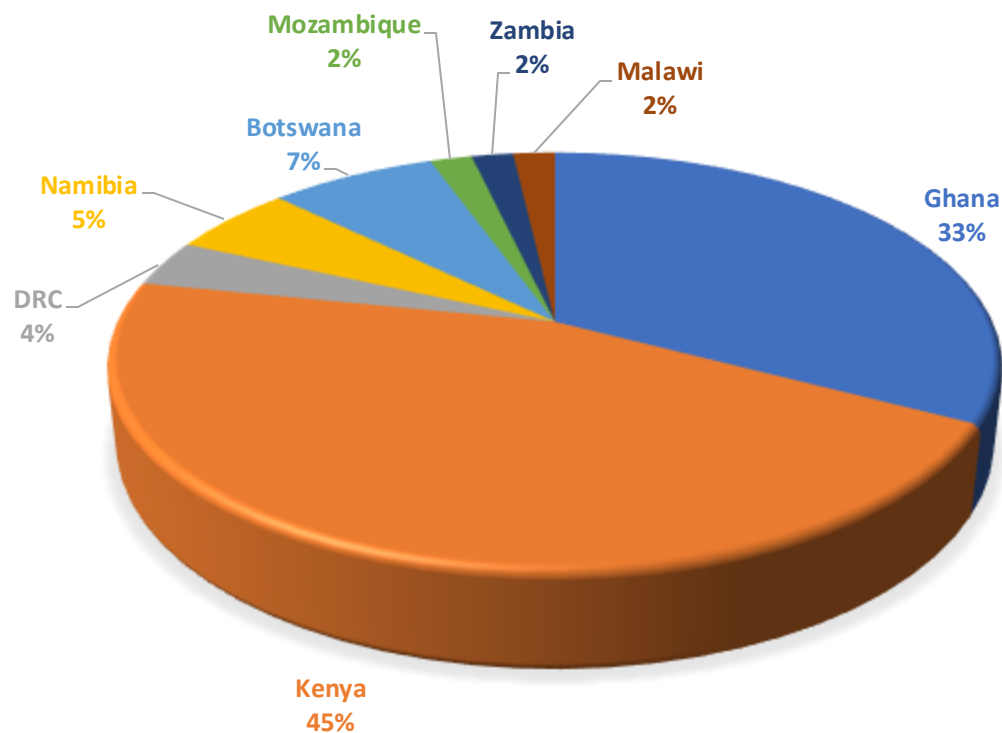


Hours Used (Million)

Total: 109 million

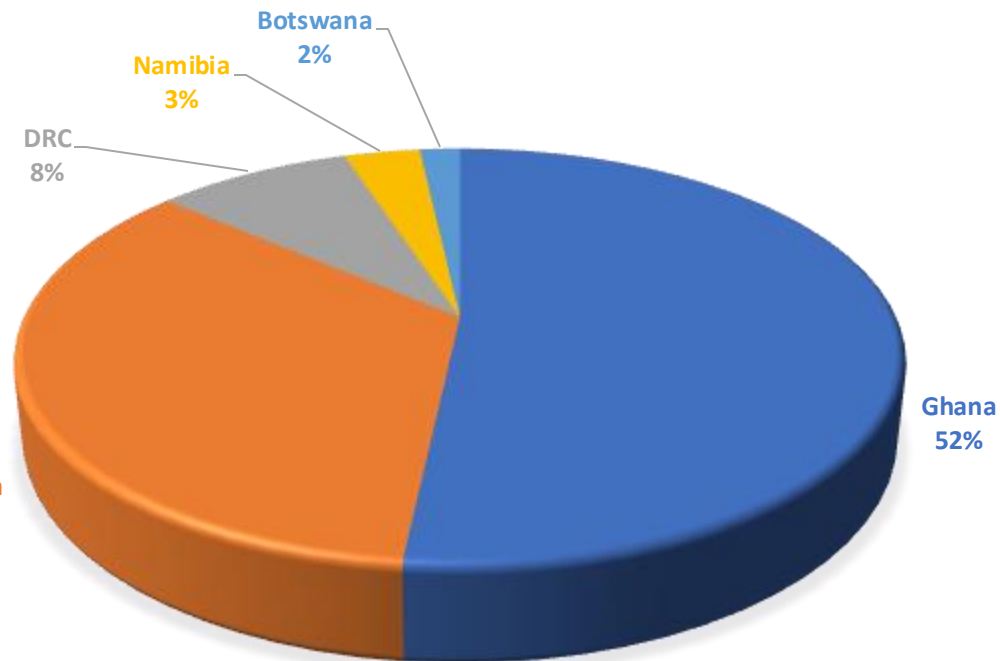
**Active refers to at least 1000 compute hours used over the relevant period.*

CHPC Use: African Partners **Total Active* Programmes** Lengau All Time



Active Programmes

Total: 55



Hours Used (Million)

Total: 174 million

**Active refers to at least 1000 compute hours used over the relevant period.*



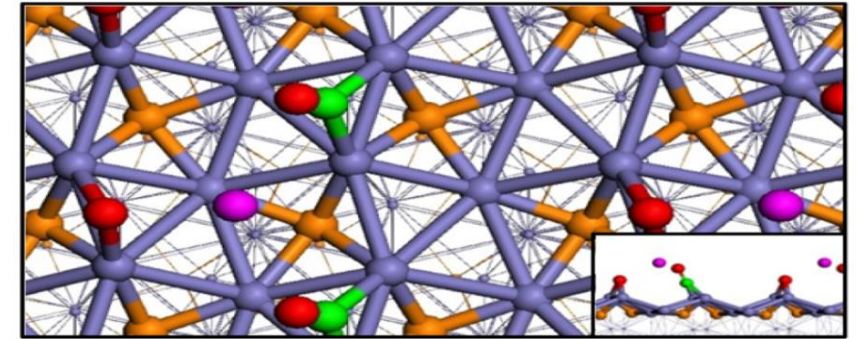
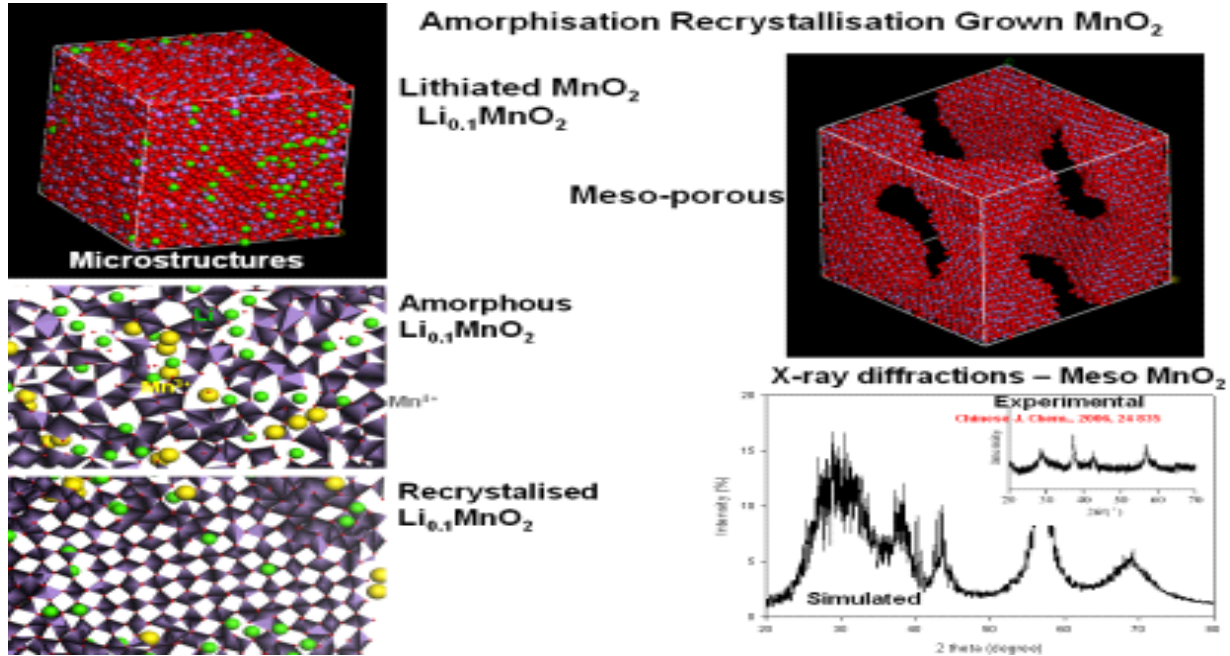
CHPC Use: Industry **Total Active* Programmes**

**Active refers to at least 1000 compute hours used over the relevant period.*

| Company | #Hours (Millions) (All Time) | % | | Company | #Hours (Millions) (All Time) | % |
|---------------------|------------------------------|------|--|-----------------------------|------------------------------|--------------|
| Johnson Matthey | 5923194 | 46.0 | | Ex Mente | 40489 | 0.3 |
| eScience | 2331554 | 18.1 | | Venter Consulting Engineers | 38051 | 0.3 |
| De Beers Marine | 897643 | 7.0 | | IGS | 34538 | 0.3 |
| Aerotherm | 801332 | 6.2 | | Structa Konsult | 31444 | 0.2 |
| Hatch | 509937 | 4.0 | | Howden South Africa | 26865 | 0.2 |
| Cauchy Consult | 431948 | 3.4 | | PABT | 23800 | 0.2 |
| Inqaba Biotec | 315584 | 2.5 | | Eskom | 21745 | 0.2 |
| Epsilon Engineering | 229477 | 1.8 | | Cinnamon Teal Aerospace | 19542 | 0.2 |
| Starke Ayres | 226635 | 1.8 | | Zutari | 17957 | 0.1 |
| Qfinsoft | 175820 | 1.4 | | Multotec | 17463 | 0.1 |
| BBE Consulting | 168401 | 1.3 | | FTT Technology, Namibia | 13383 | 0.1 |
| Zutari | 145217 | 1.1 | | Biomine Health | 10992 | 0.1 |
| Kapa Biosystems | 133260 | 1.0 | | Rotech Systems | 8585 | 0.1 |
| Mamadi & Company SA | 112318 | 0.9 | | Sebenzana Consulting | 8101 | 0.1 |
| Aim Technologies | 110390 | 0.9 | | Knight Piv©sold Consulting | 6946 | 0.1 |
| Greenplan | 86715 | 0.7 | | EnFloTech | 4296 | 0.0 |
| SMEC | 81803 | 0.6 | | EMSS Consulting | 2453 | 0.0 |
| GLPS | 75071 | 0.6 | | Nanodyn | 1748 | 0.0 |
| Agriprotein | 70780 | 0.6 | | Altair Engineering Ltd | 1351 | 0.0 |
| Mintek | 40648 | 0.3 | | TOTAL | 13197478 | 100.0 |

HPC Applications: Materials

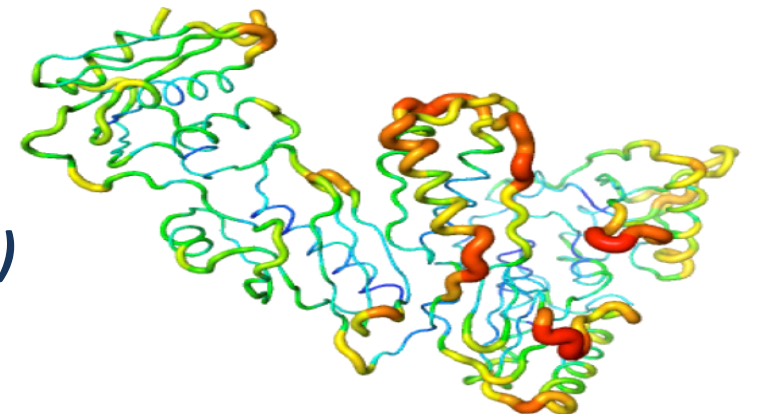
Materials Science / Chemistry / Health



**Computational Catalysis
(Comp Chem / Materials Science)**

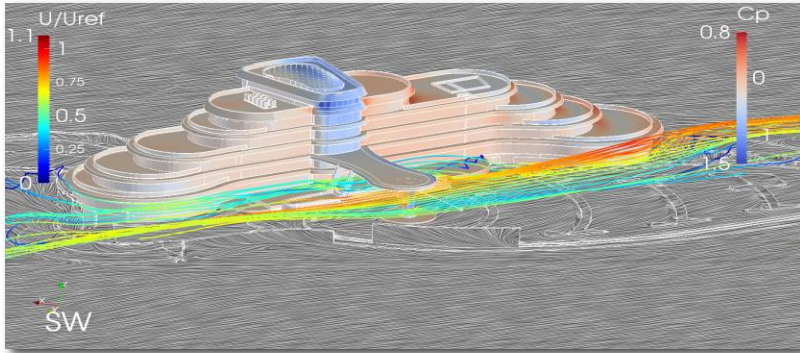
**Energy Storage – Battery
Development
(Materials Science)**

**Drug-Design Molecular
Modelling
(Computational Chemistry)**

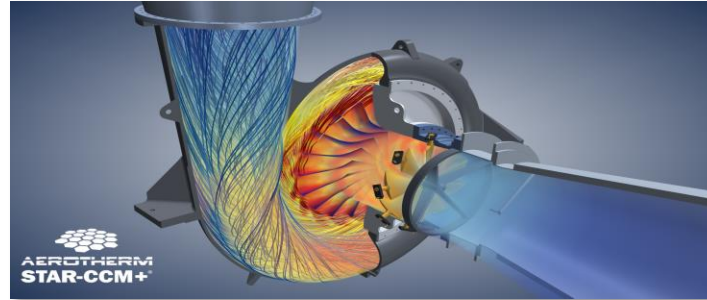


HPC Applications: Engineering

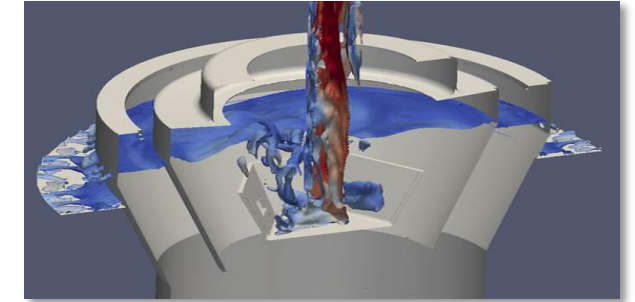
Computational Mechanics / Engineering



Building aerodynamics
(ECI-JV)

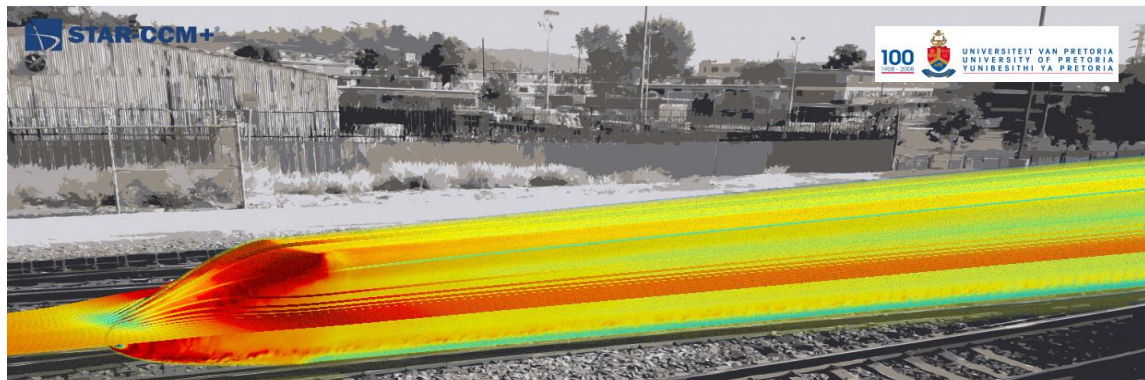


Centrifugal Steam Compressor
(Aerotherm)

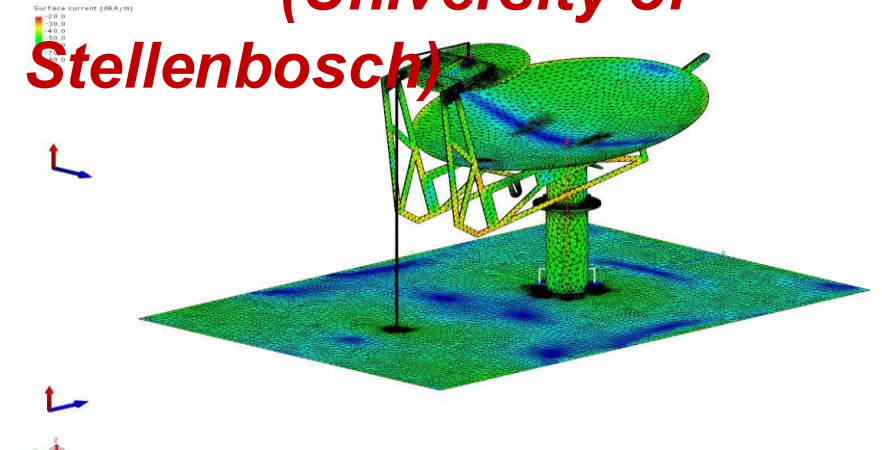


Elutriator Design
(De Beers Marine)

High-speed Train Design (UP):



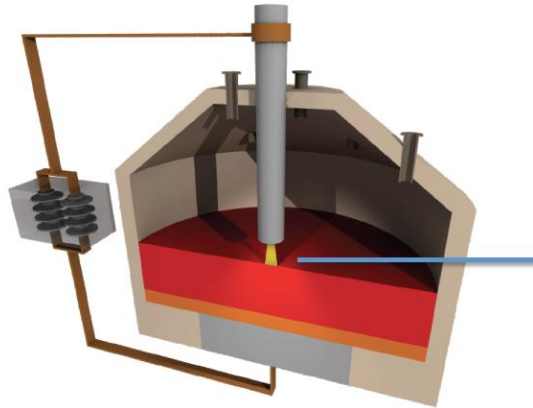
Radio-Astronomy Dish Design
(University of Stellenbosch)



HPC Applications: Engineering

CASE STUDY Mintek: Pyrometallurgy

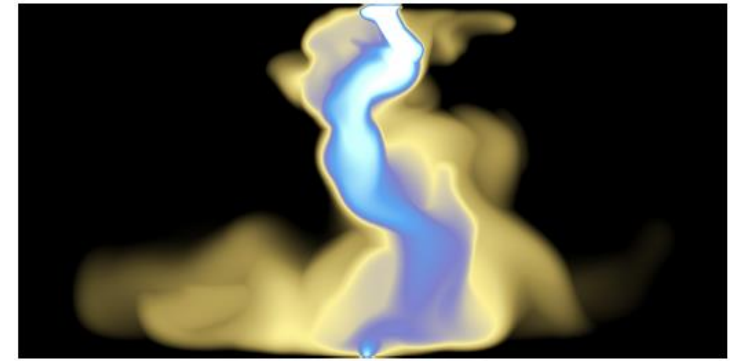
- ❑ DC Furnace **Plasma Arc electric smelting** simulations
- ❑ **CFD** and Magnetohydrodynamics (**MHD**) simulations
- ❑ Resulted in **patent** for Mintek on **arc detection technology**
- ❑ **Fully dependent** on **CHPC** for HPC resource requirements



Cross-section of DC Furnace
Showing Plasma Arc (photo)



Photographic Image



Simulated



Courtesy: Dr Quinn Reynolds (Mintek)

Introduction to CHPC

Resources at the CHPC: Cloud



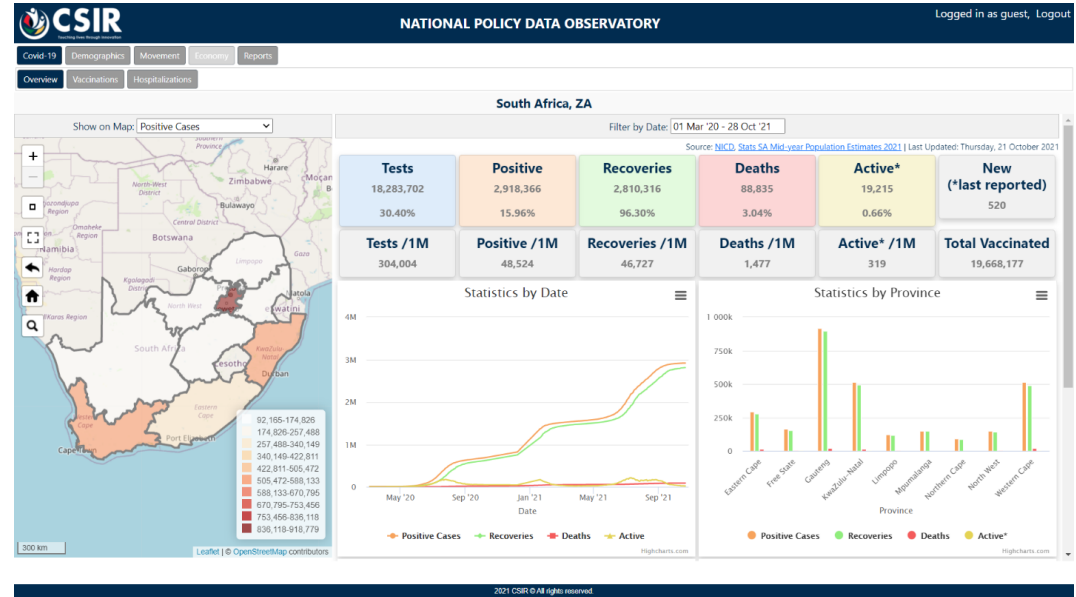
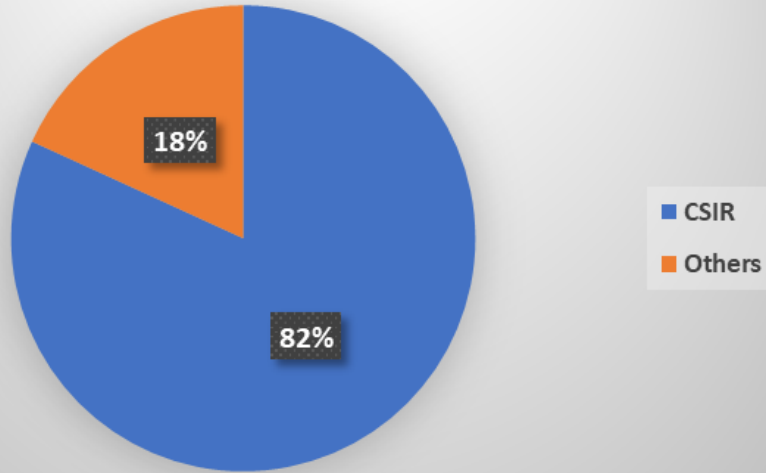
NICIS Production Cloud named: **SEBOWA**

Since March 2020...

- ❑ **Openstack** Cloud with Ceph storage
 - ❑ **320 cores** with memory of 4GB/core
 - ❑ **500 TB** of Ceph storage (2 copies)
 - ❑ **100 Gbps** speed form switch split in 4
- ➔ each node gets 25GB network speed.



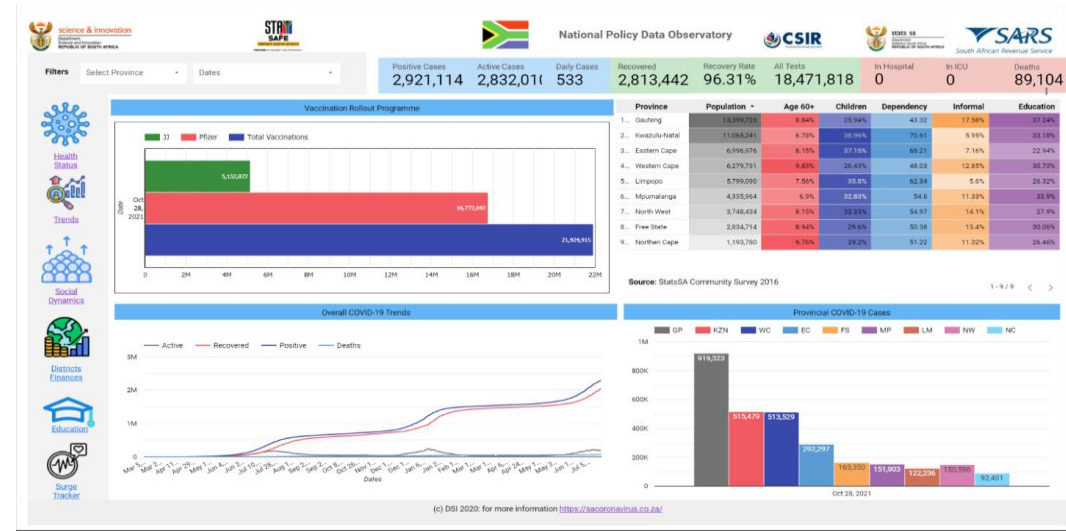
Sebowa Cloud Projects



NATIONAL POLICY DATA OBSERVATORY

Hosted on Sebowa and the data is also used for other several projects:

- NPDO dashboard - contains Covid-19, Demographic, Mobility, Financial, Report data and more.
- Goggle studio dashboard – contains Covid-19 data analysis, insights and more.
- SA's development Indicators dashboard (**New**) - tracking of South Africa's Development Indicators published by the Department of Planning, Monitoring & Evaluation on an annual basis.
- CSIR Logistics observatory platform (**New**)



Vaccine certificate systems portal

- ❑ The Vaccine certificate system portal allows vaccinated South Africans to access and download their digital Covid-19 vaccination certificates
- ❑ This project is hosted on NICIS cloud, and it runs highly scalable virtual infrastructure required to handle the extremely high load, where millions of South Africans access this portal on daily basis.

South African COVID-19 Vaccine Certificate System



health

Department:
Health
REPUBLIC OF SOUTH AFRICA

This is the official South African COVID-19 Vaccine Certificate System Portal

- Verification of the Vaccine Certificate feature is optimized for mobile devices.
- Only people who are COVID-19 vaccinated can retrieve their COVID-19 Vaccine Digital Certificate.
- If you have updated any of your personal details on EVDS, you will need to re-download your certificate.
- **The QR Code generated is not intended to be readable by the general public**, it is meant to be used by entities requiring to verify the certificate's validity, using a Vaccine Certificate System inbuilt QR scanner.
- If the certificate you have downloaded has 'version 1' on it, **please re-download a new certificate (version 2)**.

GET MY VACCINE CERTIFICATE

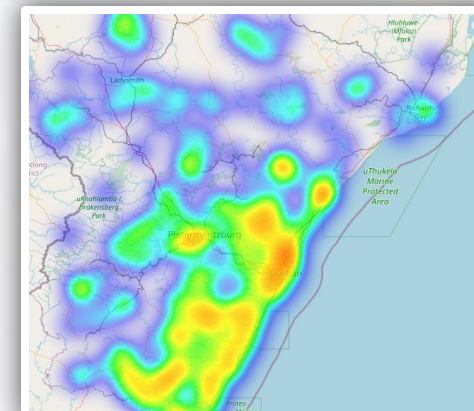
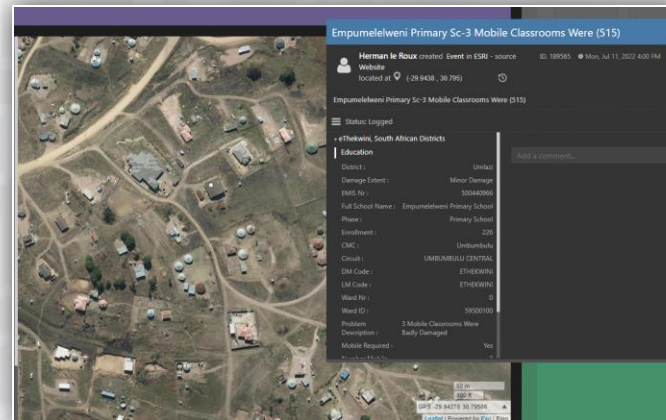
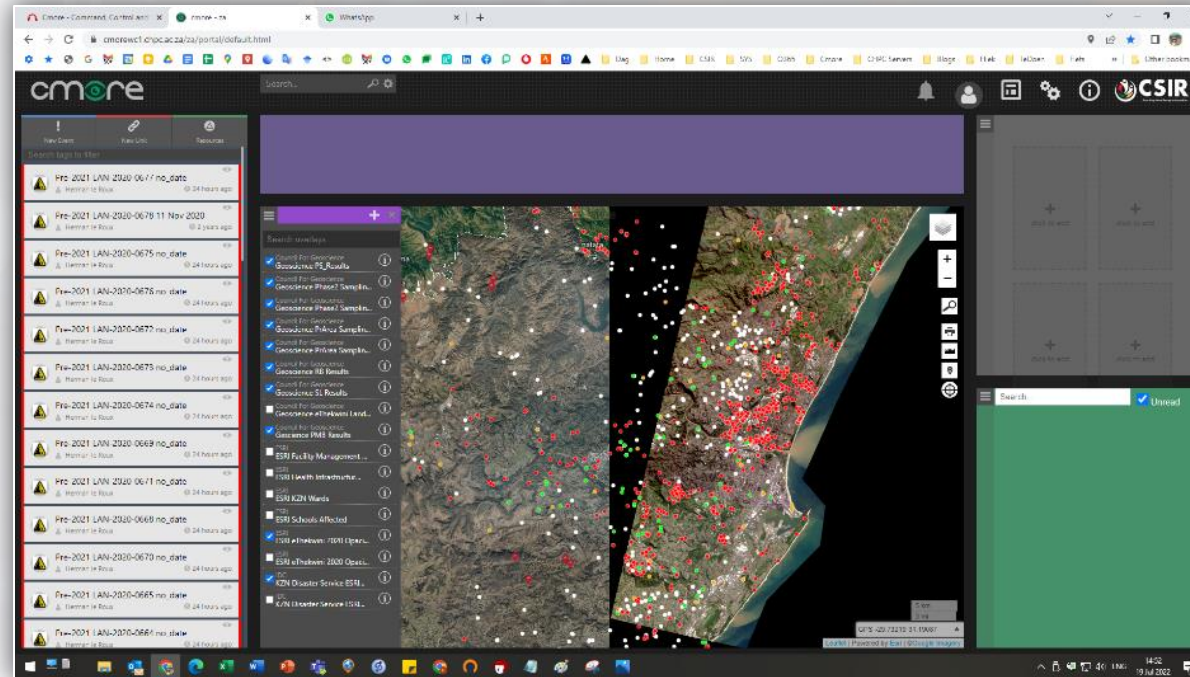
VERIFY A VACCINE CERTIFICATE

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



CMORE Project: Support to IDC/PICC on KZN Flood Data Integration

- Integration of data points and GIS overlays into a single view from various data owners
- KZN Office of the Premier
- Council for Geoscience
- Microsoft
- SANSA
- SANRAL
- ESKOM
- SAWS
- CSIR



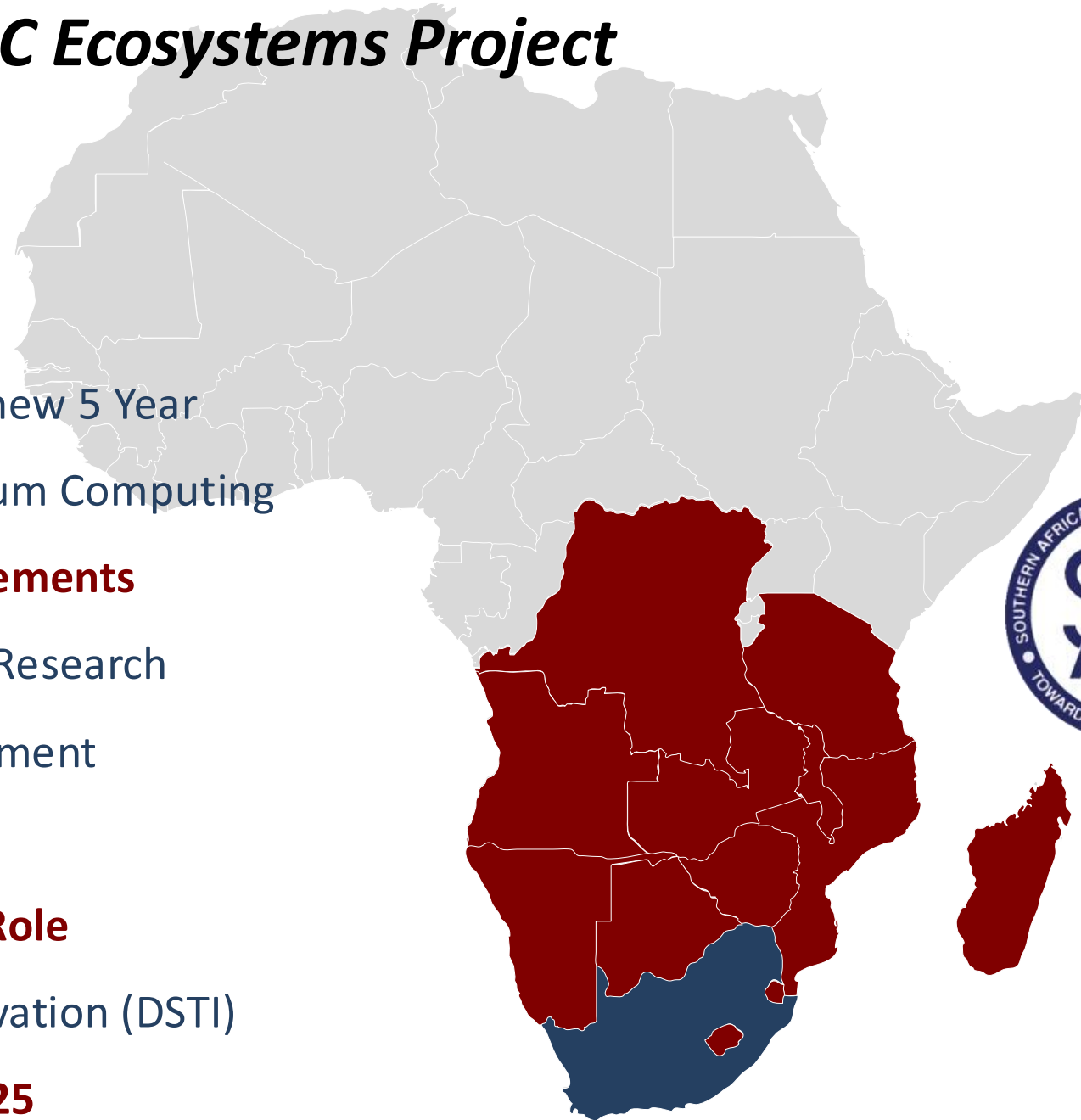
Focus on Africa

HPC Ecosystems Project

CHPC and SADC Countries

- ❑ **SADC:** 16 Countries
- ❑ **Cyber-Infrastructure** Framework
- ❑ **Ministerial** Approvals in 2025 for a new 5 Year strategy that includes AI and Quantum Computing
- ❑ **Annual** SADC Senior Officials **Engagements**
- ❑ Policies, Compute Resources, Data, Research Networks, Human Capital Development
- ❑ **Regional Integration** Focus
- ❑ CHPC within **NICIS** playing **Leading Role**
- ❑ SA Department of Science and Innovation (DSTI)

3 Year Funding started in 2025



HPC Ecosystems Project



CHPC Student Cluster Competition (SCC)

Stage 1: Local competition in South Africa

20 teams of 4 students (80 in total)

Stage 2: National Competition at CHPC Conference

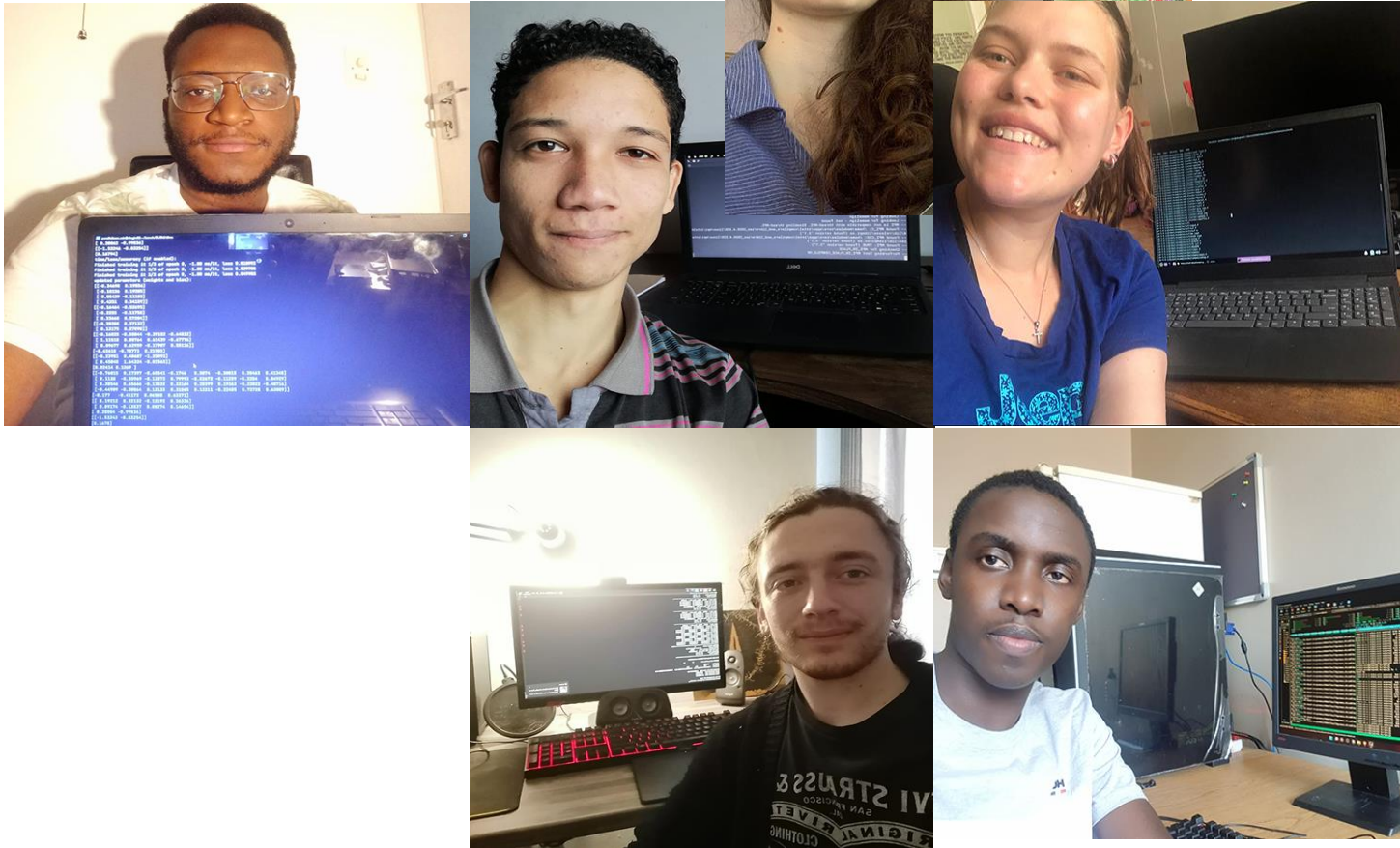
10 teams of 4 students (40 in total)

Stage 3: International Competition at ISC in Germany

1 team of 6 students



CHPC Student Cluster Competition (SCC)



- HPC Training for Undergraduates
- Over 700 student participants
- Representing 21 Tertiary Institutions
- Over 50% of participants are Black
- Over 30% are Female
- Since 2013, students achieved 4 Gold, 3 Silver and 1 Bronze at ISC



2022 Team Selected to Compete at ISC in Germany

CHPC Student Cluster Competition (SCC)

International SCC Competition (Germany)



2013 - 1st Place



2014 - 1st Place



2015 - 2nd Place



2016 - 1st Place



2017 - 2nd Place



2018 - 3rd Place



2019 - 1st Place

2020 – 2023 Participated in Virtual Competitions...

Special Highlights



Special Highlights



Thank you for your attention

nicsis

NATIONAL INTEGRATED
CYBERINFRASTRUCTURE SYSTEM