

**CONTEXTUAL REVIEW, ASSESSMENT OF IMPACT
AND ADVICE ON THE WAY FORWARD**

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STRATEGIC CONTEXT

Review initiatives within the Physics community in SA

- **Shaping the Future of Physics in South Africa – DST, NRF and SAIP**
- **Benchmark Statement**
- **Review of Undergraduate Physics Education in Public Higher Education Institutions Project: SAIP-CHE Partnership**

Policy Imperatives

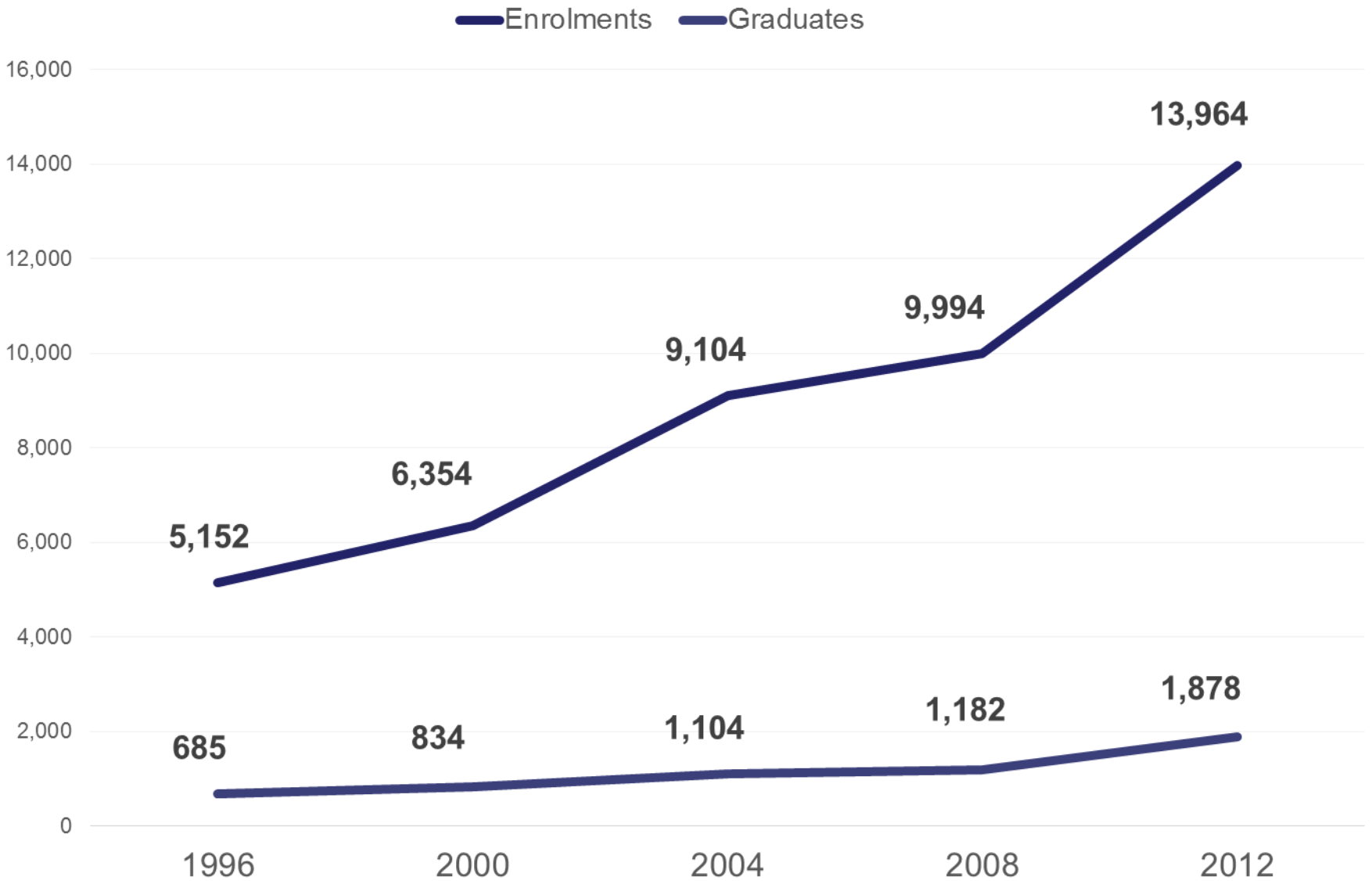
- **DST Ten-Year Innovation Plan**
- **DHET White Paper on Post-School System in SA**
- **National Development Plan – Vision 2030**

Significant Milestone

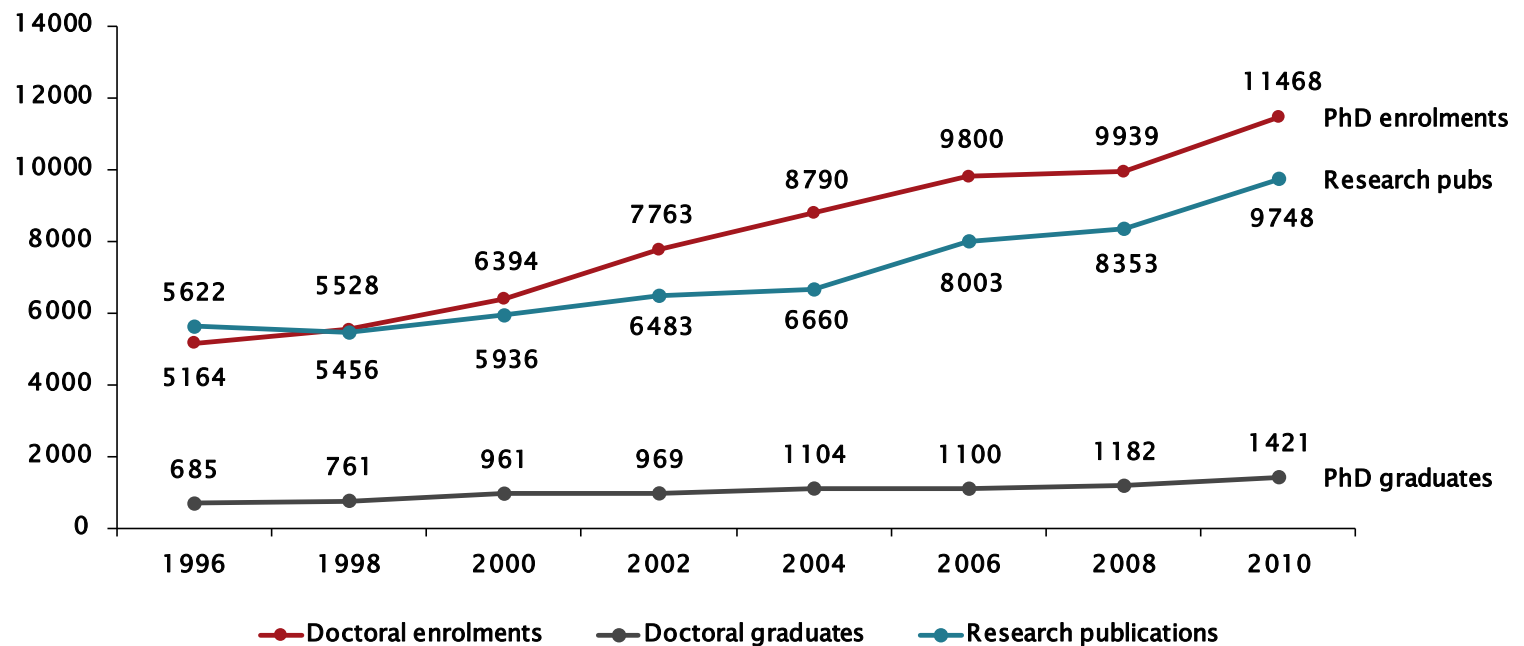
- **SAQA recognition of SAIP as a Professional Body**
- **Review of Undergraduate Physics Education in Public Higher Education Institutions Report**
- **SAIP Strategy on the Enhancement of Physics Training in SA**

PERVASIVE REALITIES

PhD enrolments and graduates in SA: 1996-2012 [Source: DHET (2013)]

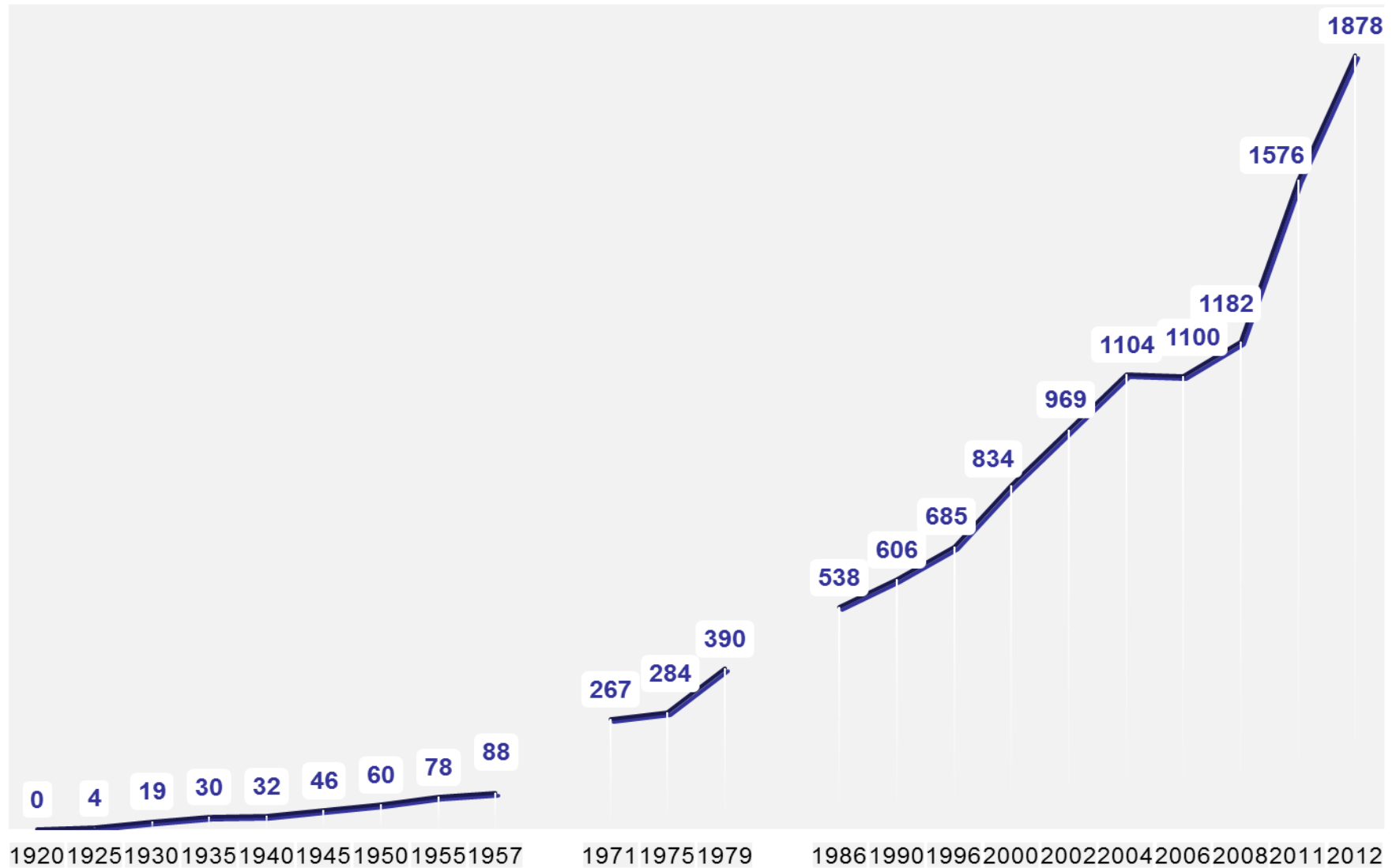


Doctoral enrolments, doctoral graduates and research publications in SA

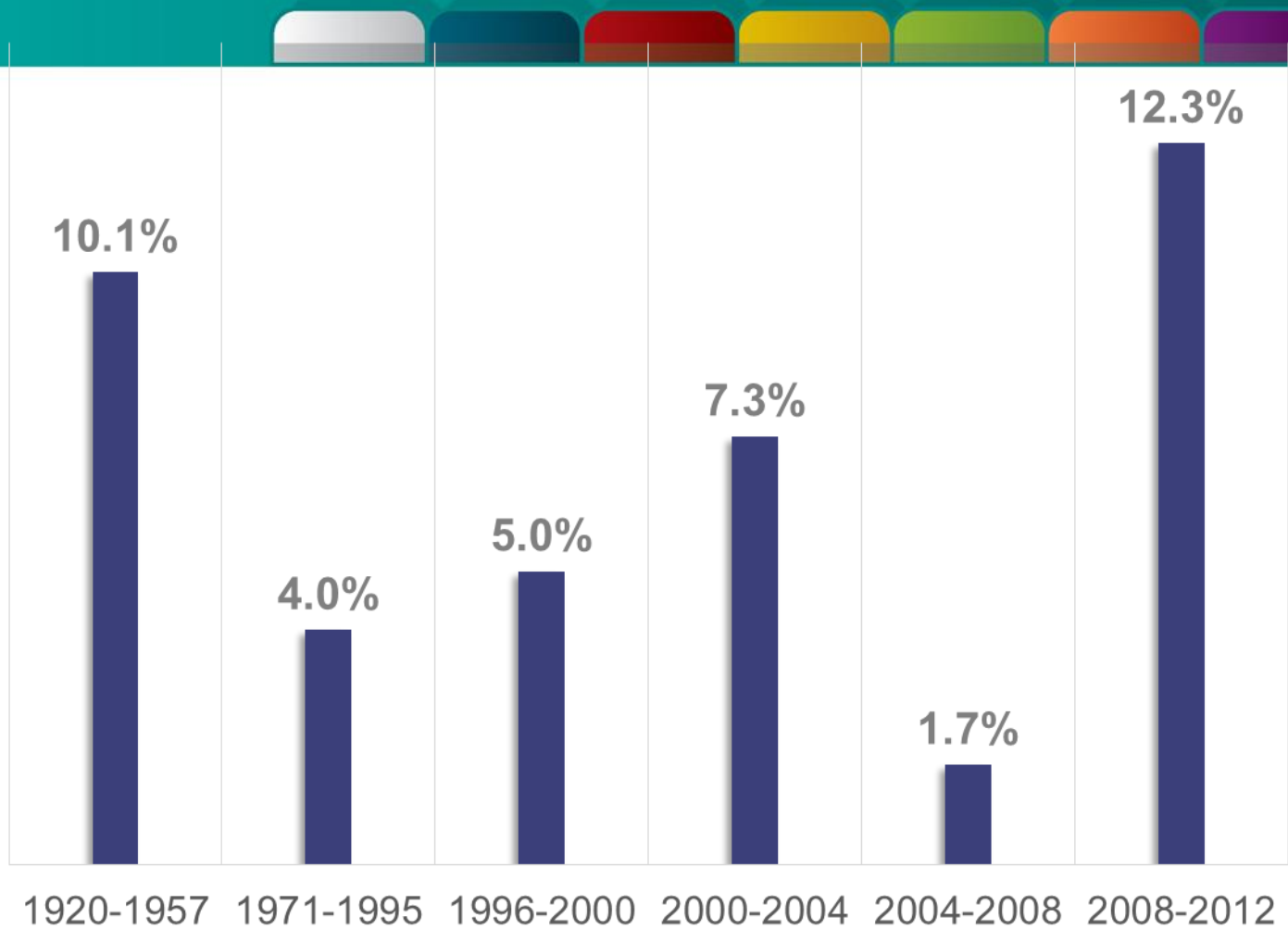


Growth in Doctoral graduates in SA: 1920 – 2012

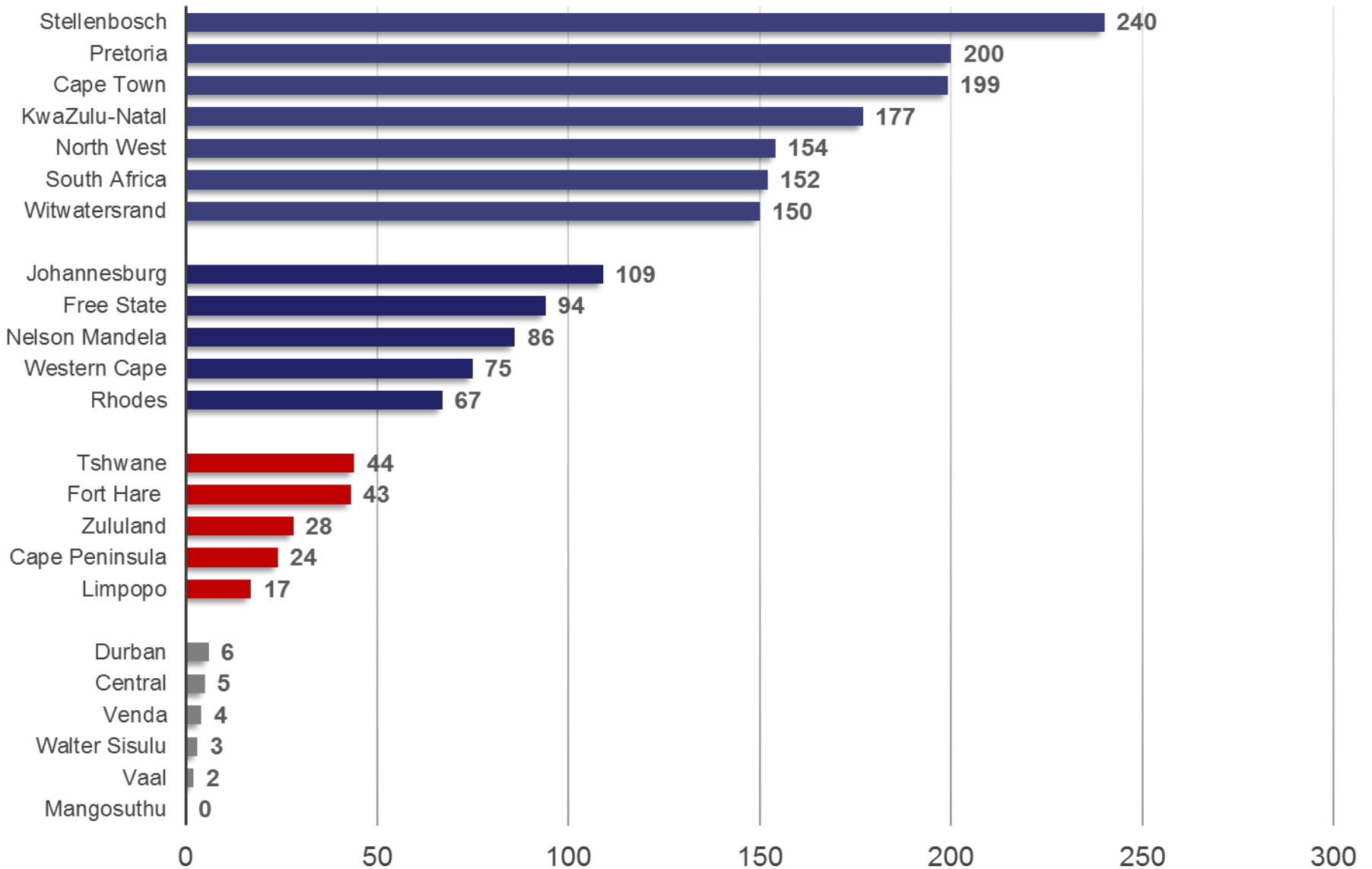
Sources: Garbers (1960), DNO (1982), DoE (1999), DHET (2013)



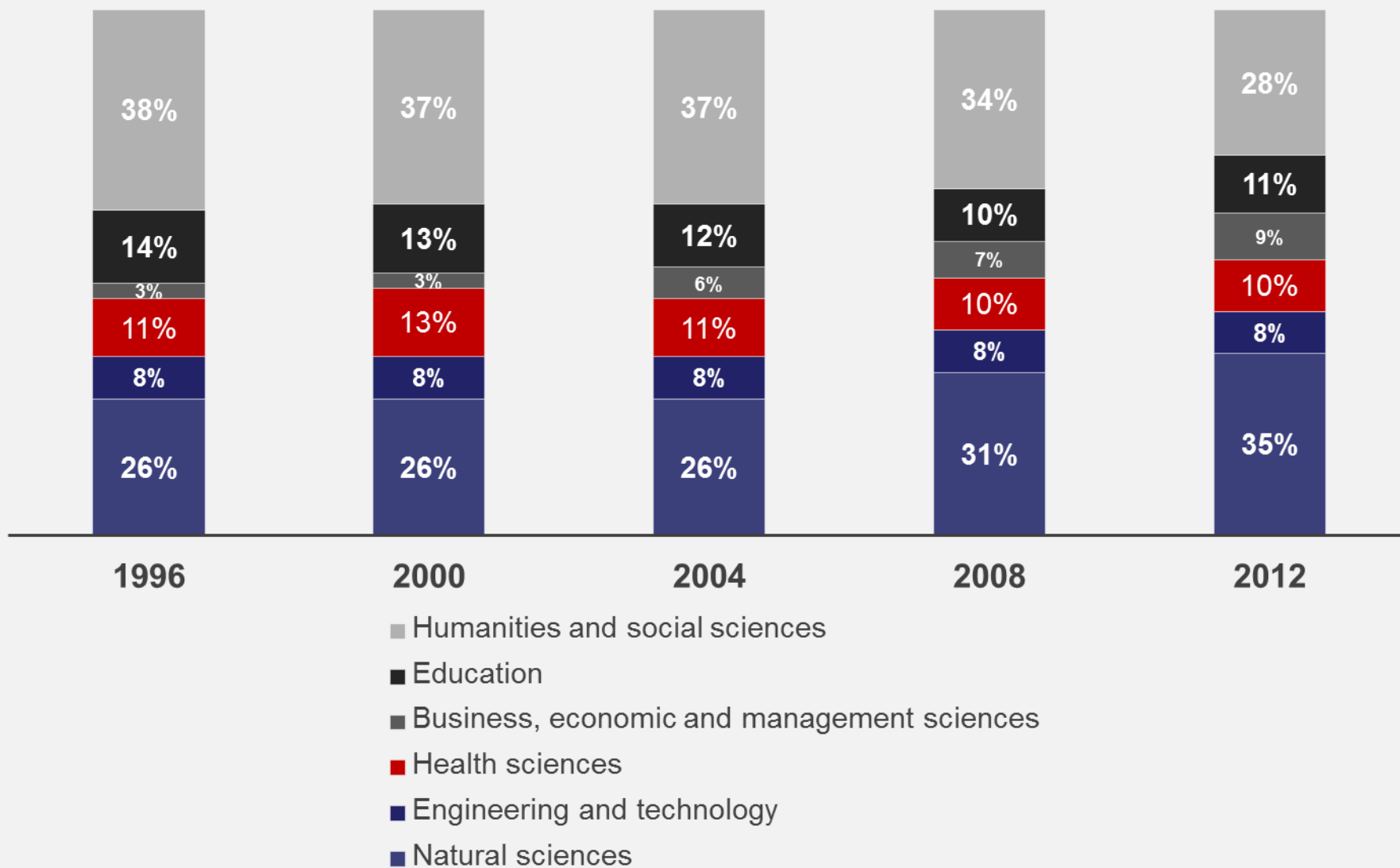
Average annual growth rate of Doctoral graduates in SA: 1920 – 2012



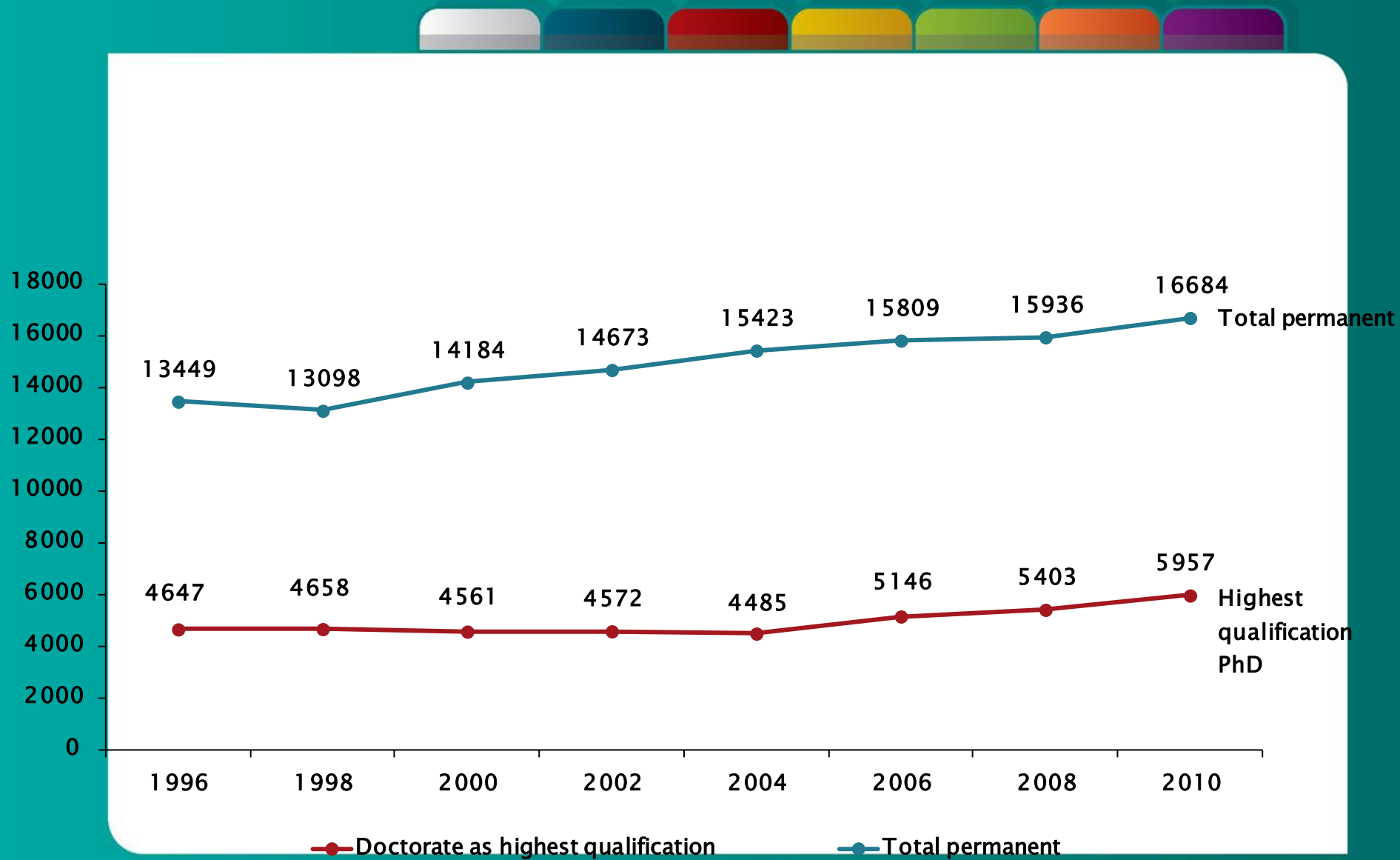
Doctoral graduates produced by SA universities in 2012



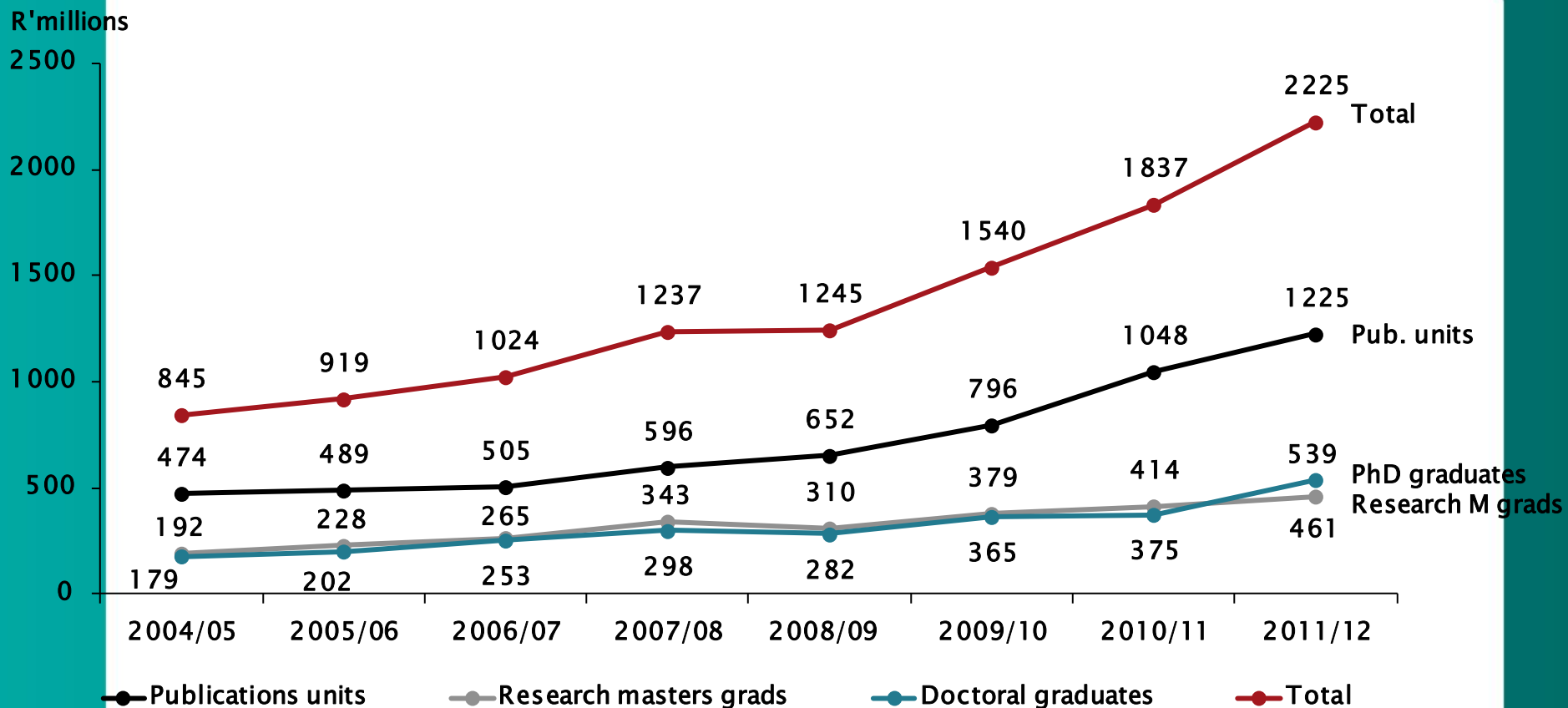
Average shares of the doctoral graduates in the various fields of study



Permanent Academic Staff

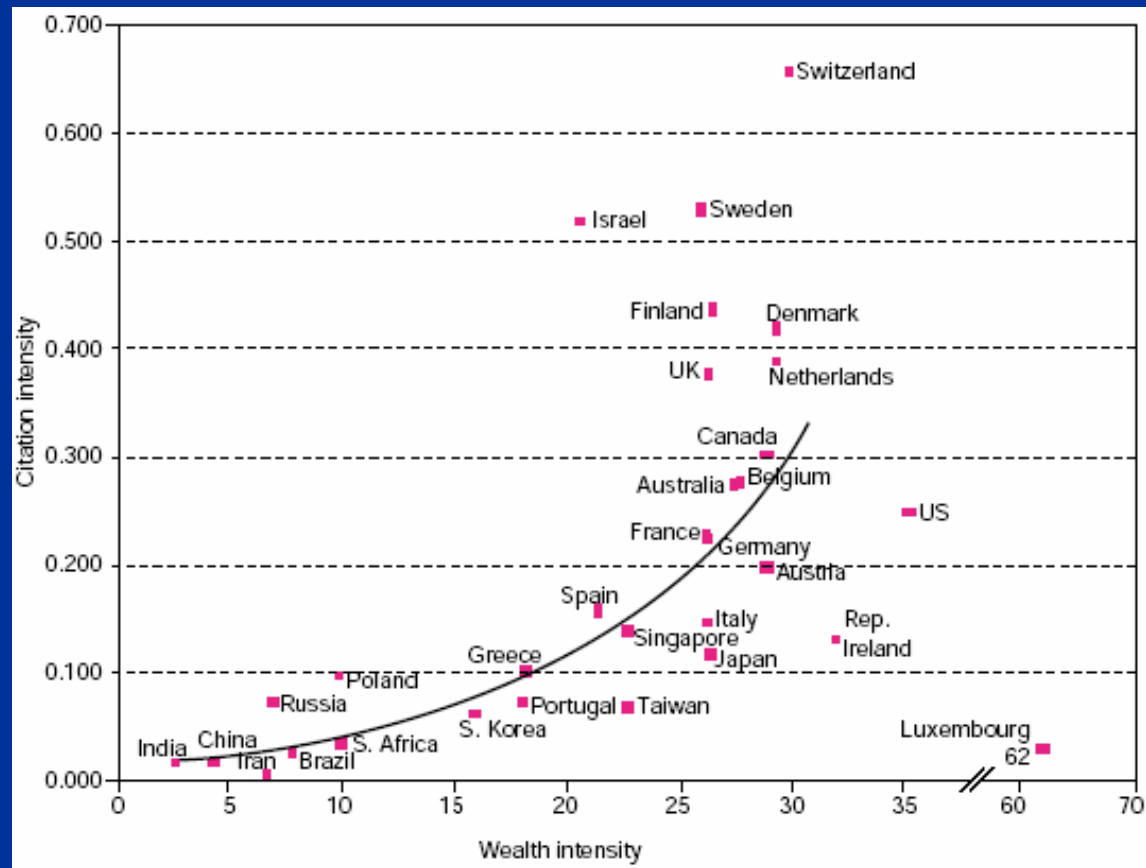


Government research funding allocations by output category and financial year



Link between citation and wealth intensities

(Sources: Thomson ISI, OECD and the World Bank)



IMPACT OF EXISTING SCIENTIFIC INTERVENTIONS

Teacher Development Project

SAIP – IOP (UK) Partnership



Prince Edward





British
High Commission
Pretoria

CERTIFICATE OF ACHIEVEMENT

THIS CERTIFICATE IS PRESENTED TO:

SOUTH AFRICAN INSTITUTE OF PHYSICS

THIS AWARD IS TO ACKNOWLEDGE EXCELLENCE IN THE CATEGORY OF
SCIENCE AND INNOVATION

FOR THE PROJECT "PHYSICAL SCIENCE TEACHER DEVELOPMENT PROJECT"

AS SUPPORTED BY THE UNITED KINGDOM'S PROSPERITY FUND, AND THE BRITISH HIGH COMMISSION
SOUTH AFRICA, 2015-2016.

DATE: *07 September 2016*



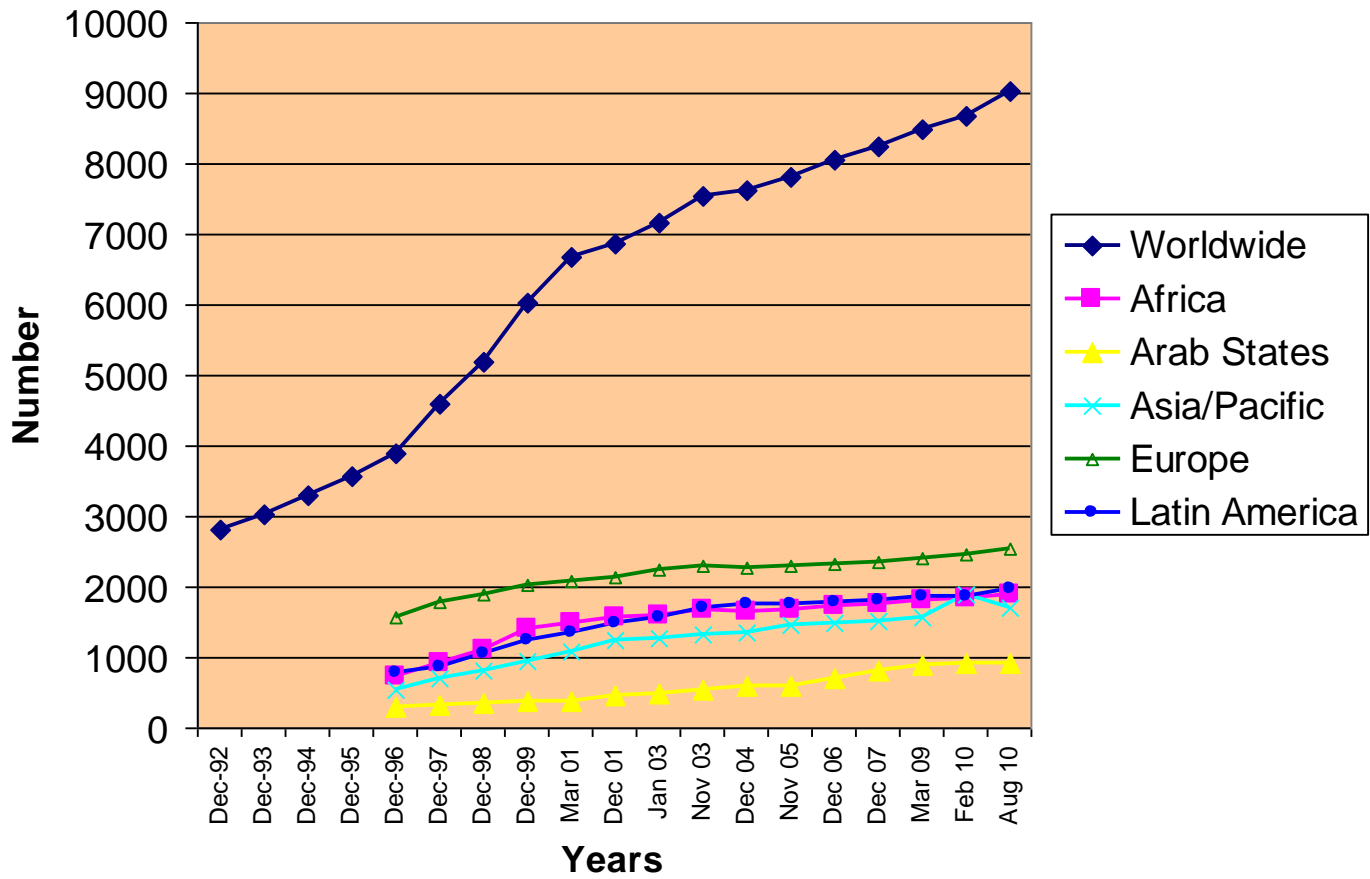
SIGNATURE:

DAME JUDITH MACGREGOR
BRITISH HIGH COMMISSIONER

ASPnet: 'A Quality Network for Quality Education'

ASPnet is a network of committed schools engaged in fostering and delivering quality education in pursuit of peace, liberty, justice and human development in order to meet the pressing educational needs of children and young people throughout the world.

ASPnet schools 1992-2010



National Institute of Theoretical Physics (NITheP)

Vision

- **To be Africa's leading and an internationally competitive research and training institute in theoretical physics, a discipline that provides the conceptual framework for the natural sciences**

Mission

- **Aims to sustain a stimulating theoretical physics research and user facility that links South Africa internationally through excellence in research and training, thereby supporting scientific innovation, transformation and socio-economic development in South Africa**

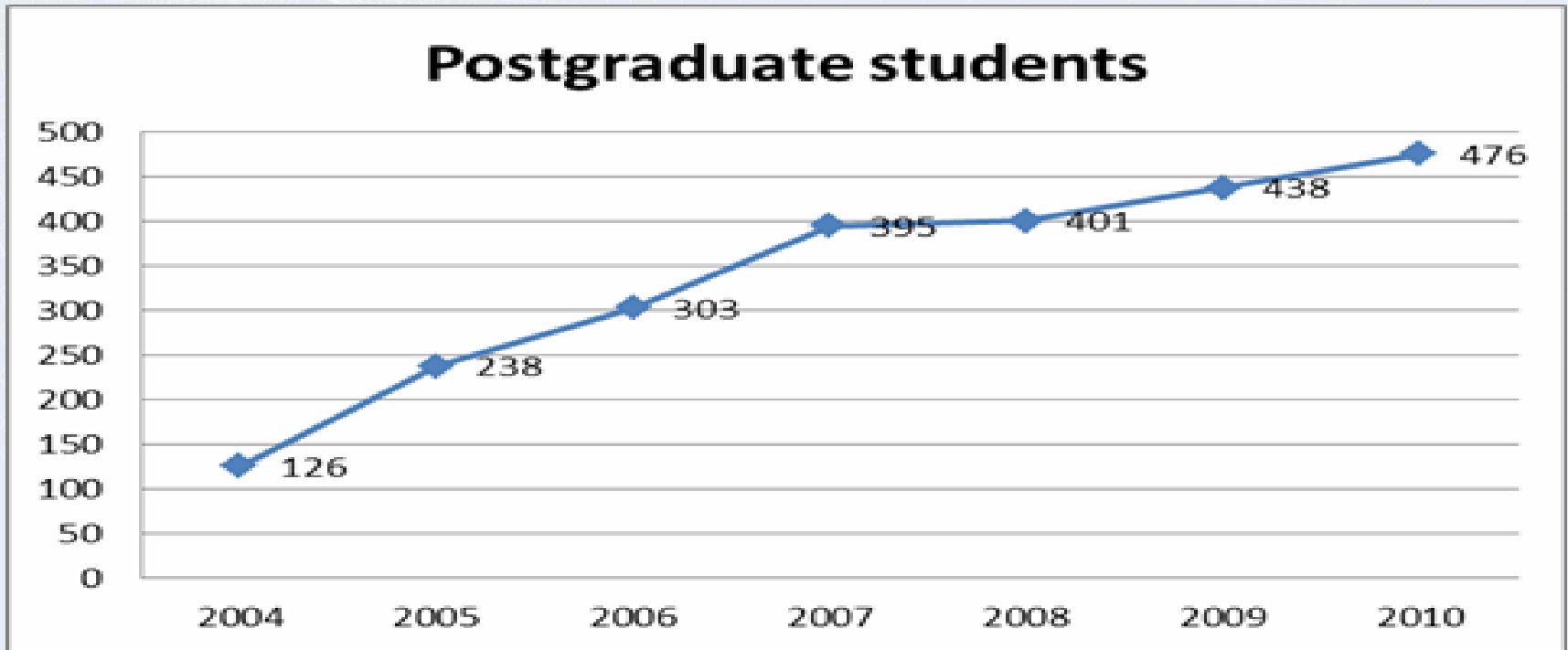
MSc and PhD students under NITheP supervision who graduated during the period 2009-2016 (Source: 2016 NITheP Annual Report)

Year	Number of graduates
2009	3
2010	11
2011	9
2012	7
2013	6
2014	14
2015	12
2016	4

Centres of Excellence

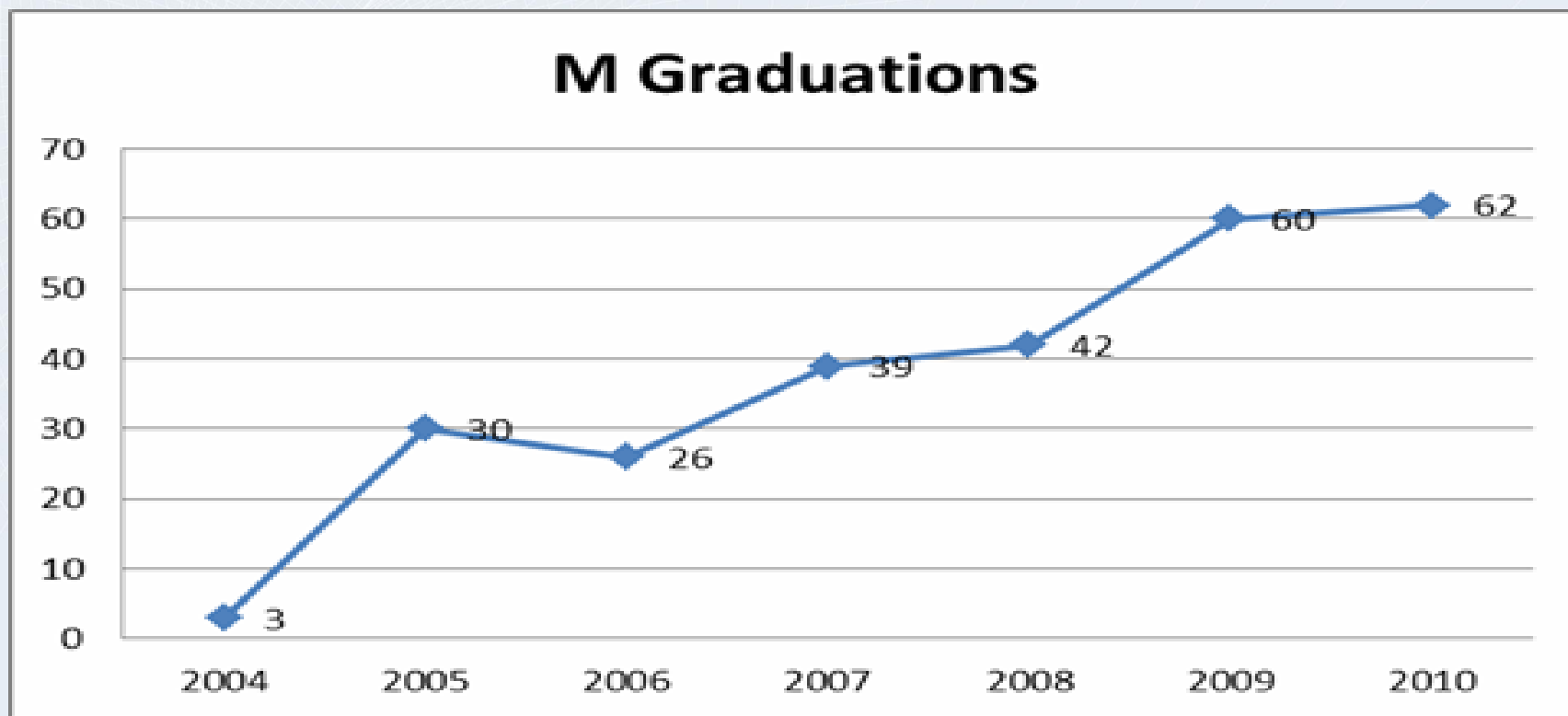
Total number of postgraduate students (Masters and Doctoral)

supported: 2004-2010 [Source: Department of Science and Technology]



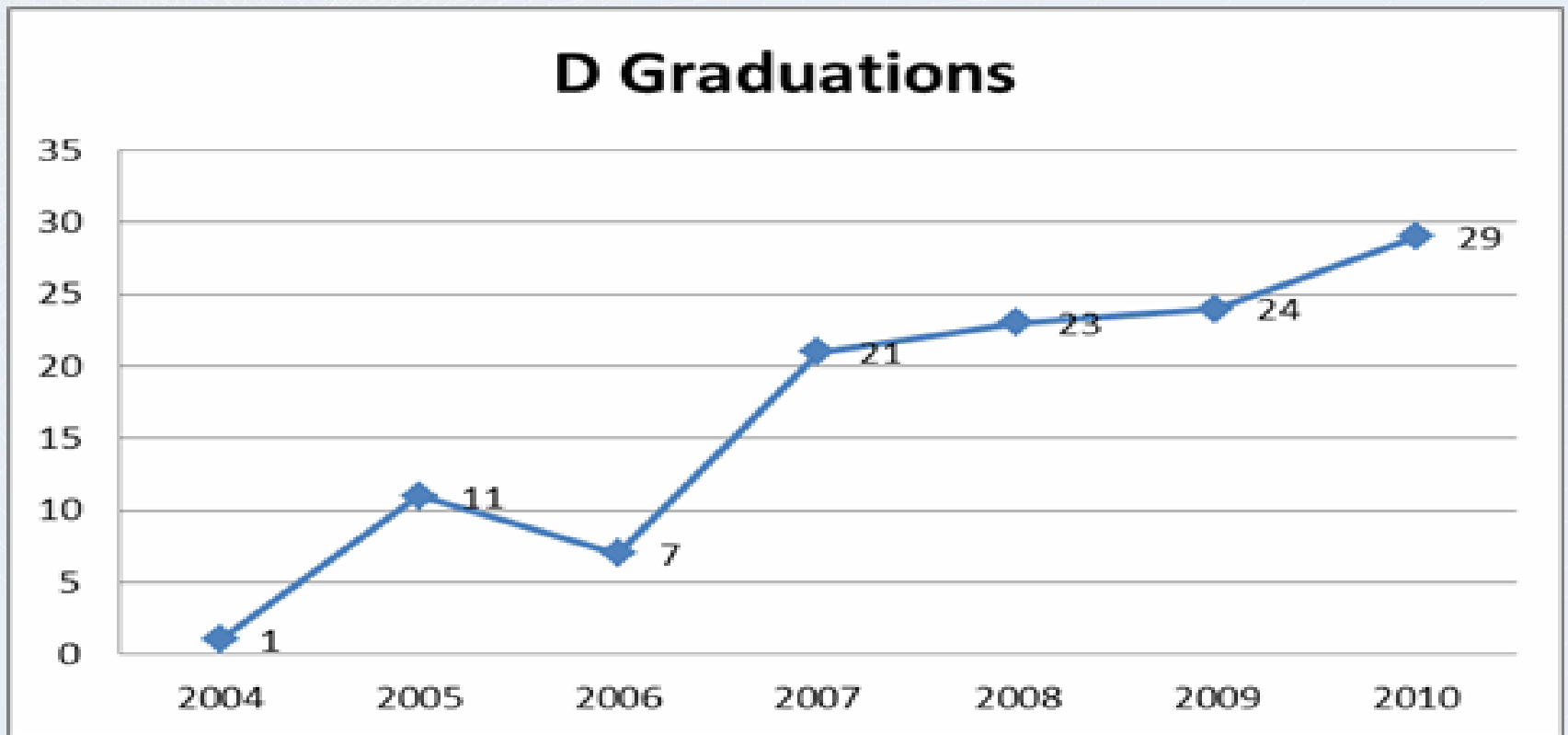
Masters Graduation (CoE)

Masters Graduations: 2004-2010



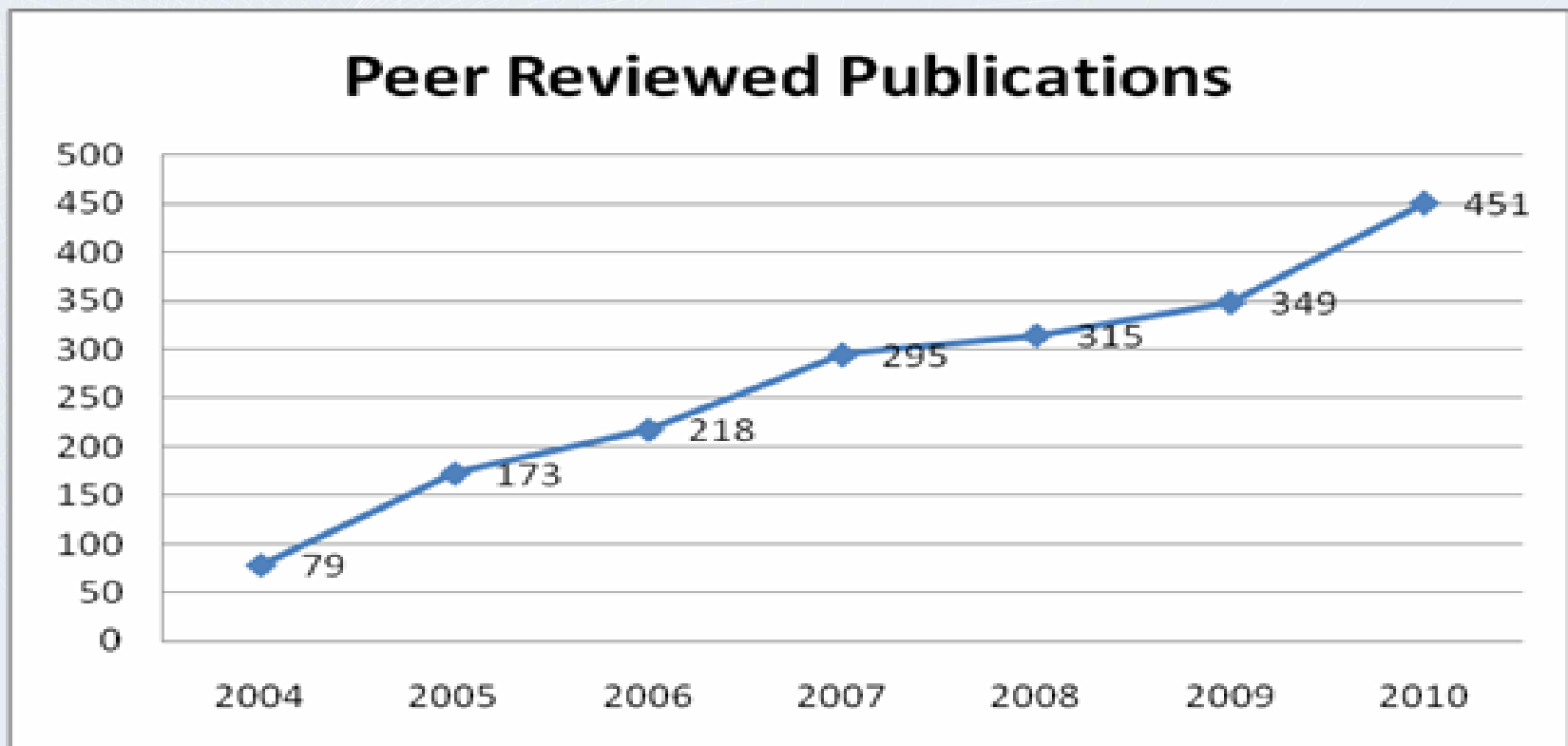
Doctoral Graduations (CoE)

Doctoral Graduations: 2004-2010



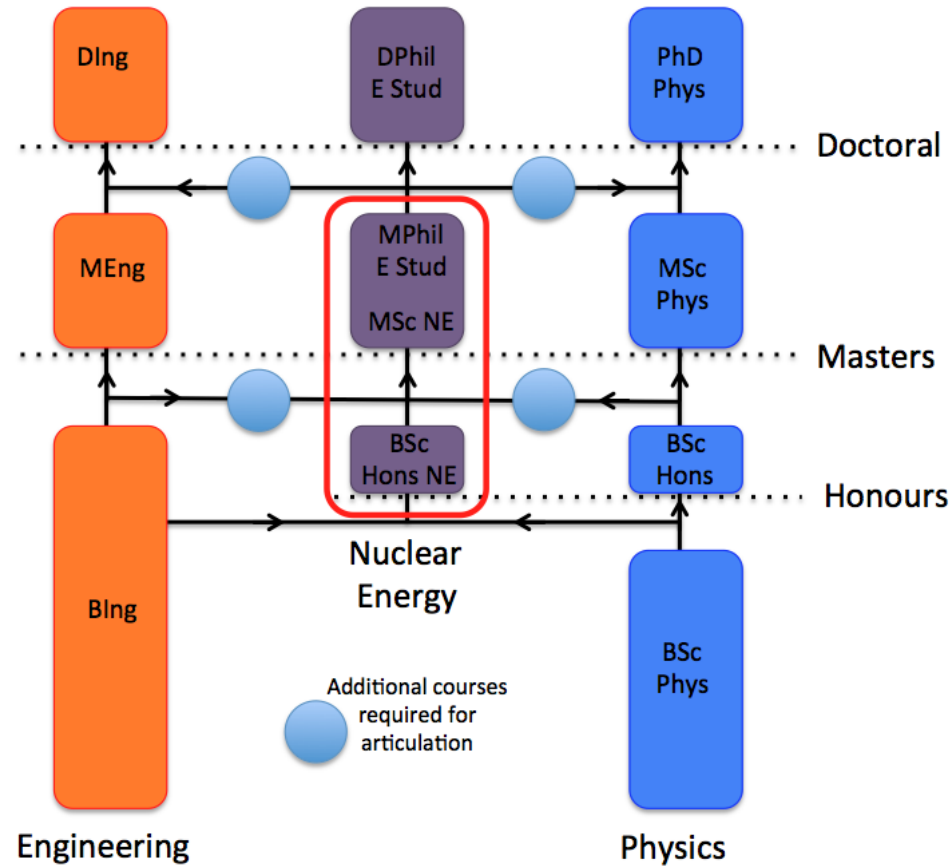
Peer Reviewed Publications (CoE)

The total number of Peer Reviewed Publications: 2004-2010



M'SONE: The Masters in the Science and Organization of Nuclear Energy

**Collaboration between University and industry partners
(Necsa and iThemba LABS)**



M'SONE Honours and Masters intake

	Honours	Masters
2010	13	
2011	7	6
2012	10	3
2013	8	6
2014		3

M'SONE Awards

Year	Student	Event	Award
2011	E Chinaka	SANHARP 2nd Annual Post Graduate Conference	Overall best poster presentation
2012	E Chinaka	NRF-DST Internship Research Day	Overall best poster presentation
2012	R Brayshaw	SAIP Annual Conference	Best MSc oral presentation, (Nuclear, Particle and Radiation Physics Division)
2013	O Oluwalye	SAIP Annual Conference	Best MSc oral presentation (Applied Physics Forum)
2014	S Chifamba	SAIP Annual Conference	Runner-up MSc Oral presentation (Nuclear, Particle and Radiation Physics Division)
2015	S Chifamba	UJ Graduation Ceremony	Chancellor's Research Award

6 students achieved Cum Laude in their MPhil / MSc

2010 File Photograph: M'SONE students in the Lecture Theatre



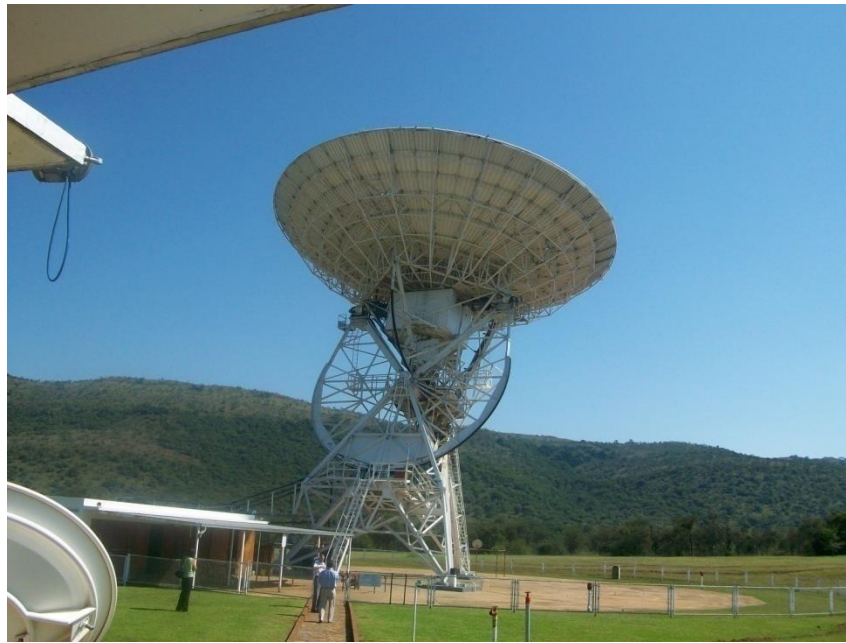
2010 File Photograph: M'SONE students performing a Computer Practical on the Necsas OSCAR code



**2011 File Photograph: M'SONE students performing Lab work at
iThemba LABS**

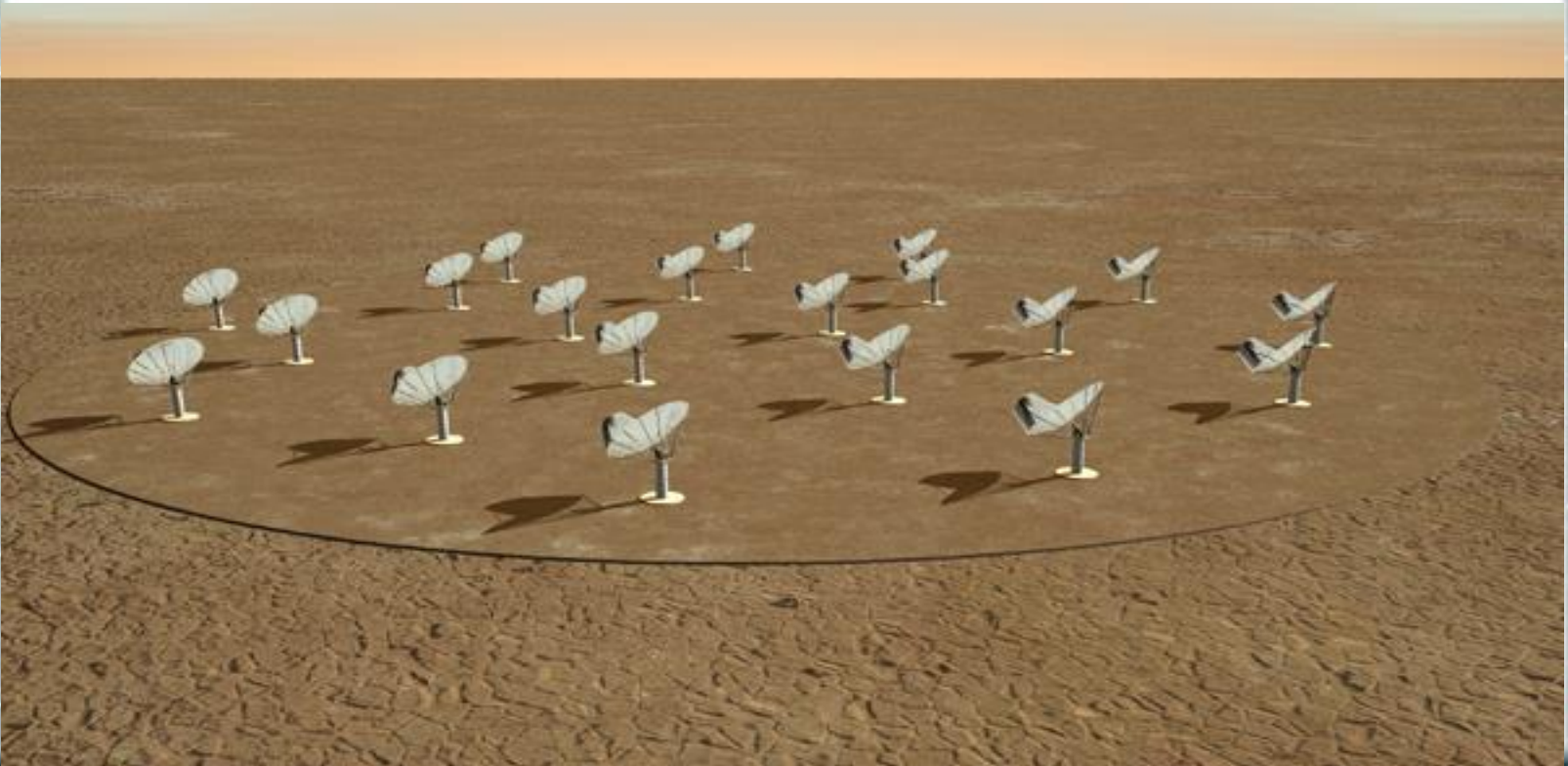


Square Kilometer Array (SKA)

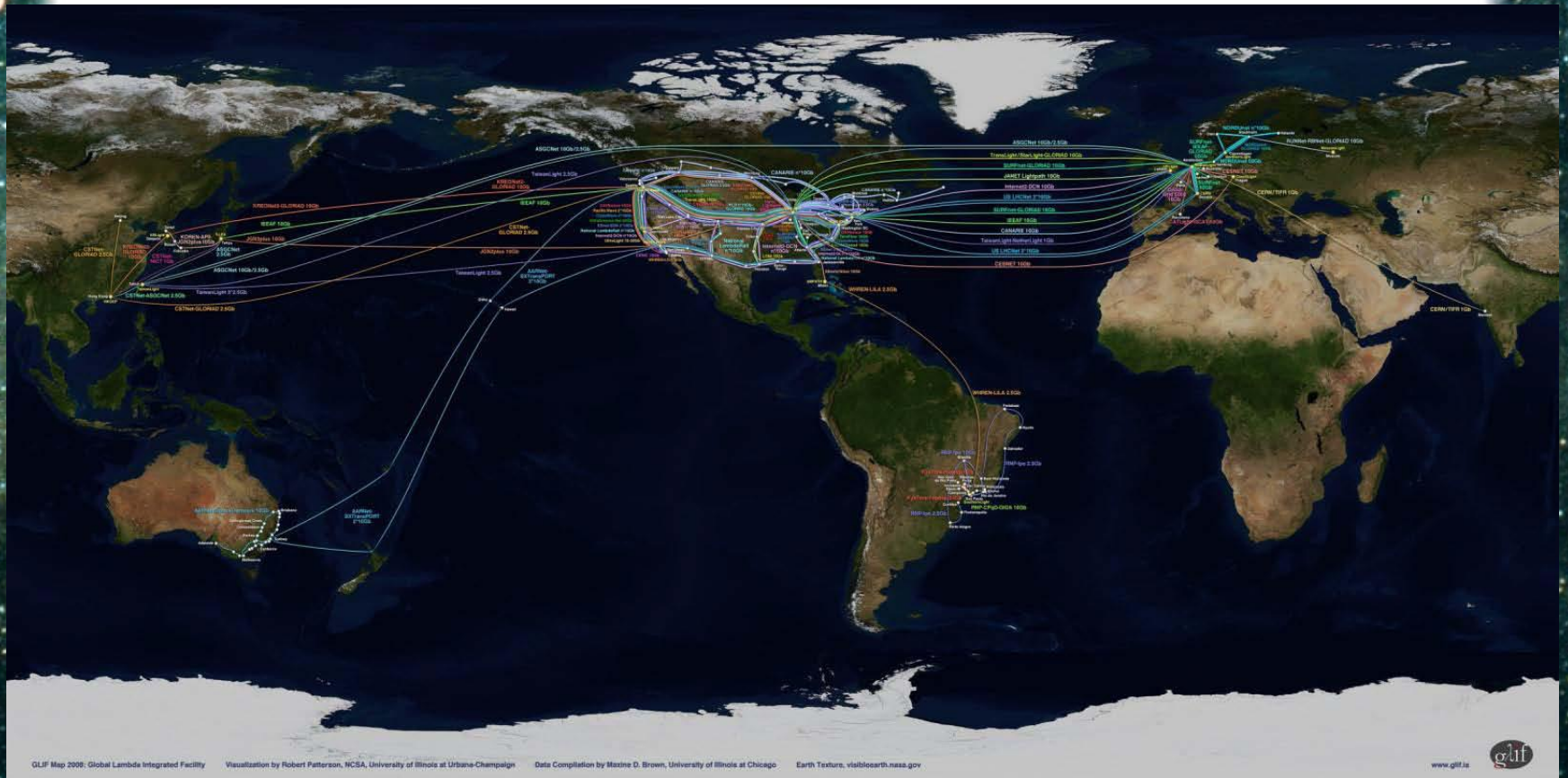


Why Should Africa Host SKA?

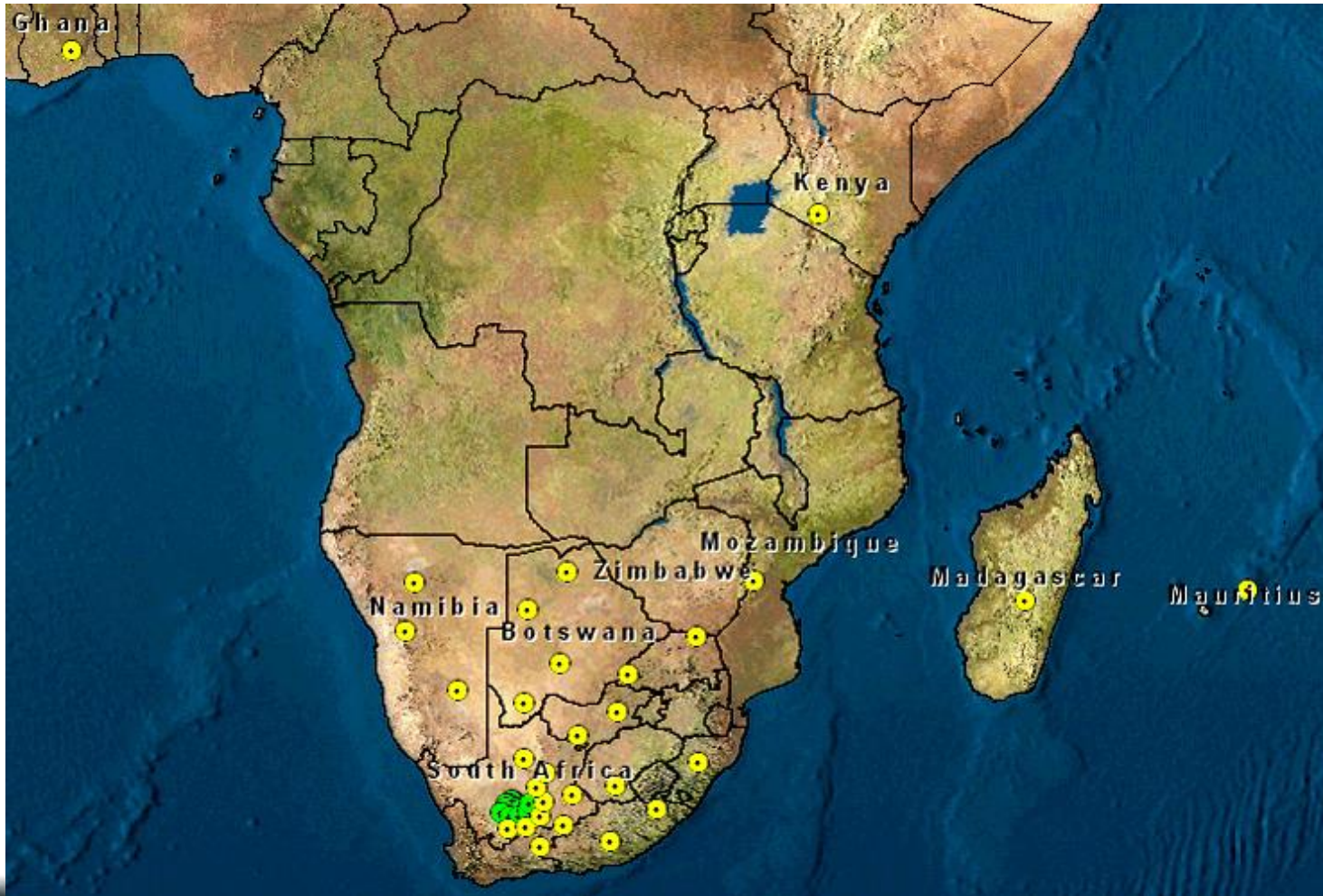
- **Economic Growth**
- **Scientific and Technological Growth**



High Speed Internet Without Africa



Dishes in South Africa, Namibia, Botswana, Mauritius, Mozambique, Madagascar, Zambia, Ghana and Kenya



SKA Human Capacity Development

- **SKA school programmes - High School interventions**
- **SKA technical skills training - Artisan training programme**

HCD by SKA South Africa over the last ten years

[Source: Socio-Economic Assessment of SKA Phase 1 in South Africa, 2017]

- **61 Doctoral students have graduated (73% graduation rate)**
- **116 Masters students have graduated (98% graduation rate)**
- **88 Honours students have graduated (97% graduation rate)**
- **85 undergraduate students have graduated (75% graduation rate)**
- **28% (17) of Doctoral students have gone into Postdoctoral Fellowships**
- **35% (48) of Masters students have gone on to do a Doctoral degree**
- **47% (46) of Honours students and Bachelor of Engineering students have gone on to do a Master's degree**
- **89% (67) of Undergraduate students have gone on to do an Honours degree**
- **65% (22) of National Diploma students have gone into Bachelor of Technology.**

**Bursaries allocated to other African countries as part of robust network of
intra-African collaboration**

[Source: Socio-Economic Assessment of SKA Phase 1 in South Africa, 2017]

Country	Number of bursaries
Ghana	6
Namibia	60
Zambia	5
Mozambique	4
Madagascar	31
Mauritius	17
Kenya	18
Botswana	16

The National Astrophysics and Space Science Programme (NASSP)

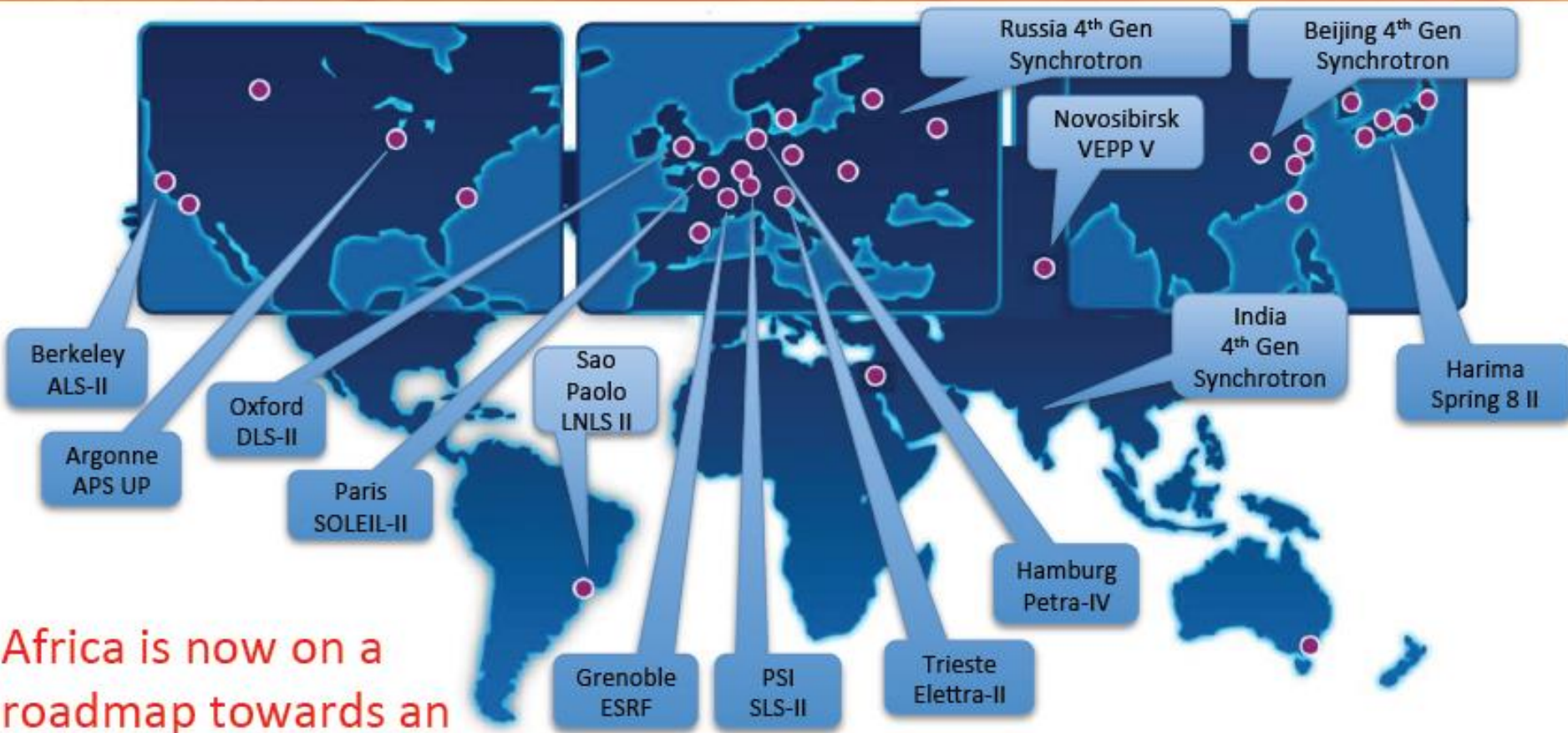
- **NASSP is a multi-institutional initiative aimed at producing graduates in areas pertaining to astronomy, astrophysics and space science**
- **NASSP positions itself as a Human Capital Development project**

Number of students who passed BSc Honours over time

Source: NASSP Review Report (2012)

Year	Number of Students
2003	12
2004	10
2005	10
2006	16
2007	13
2008	11
2009	16
2010	16
2011	15

The African Light Source Project



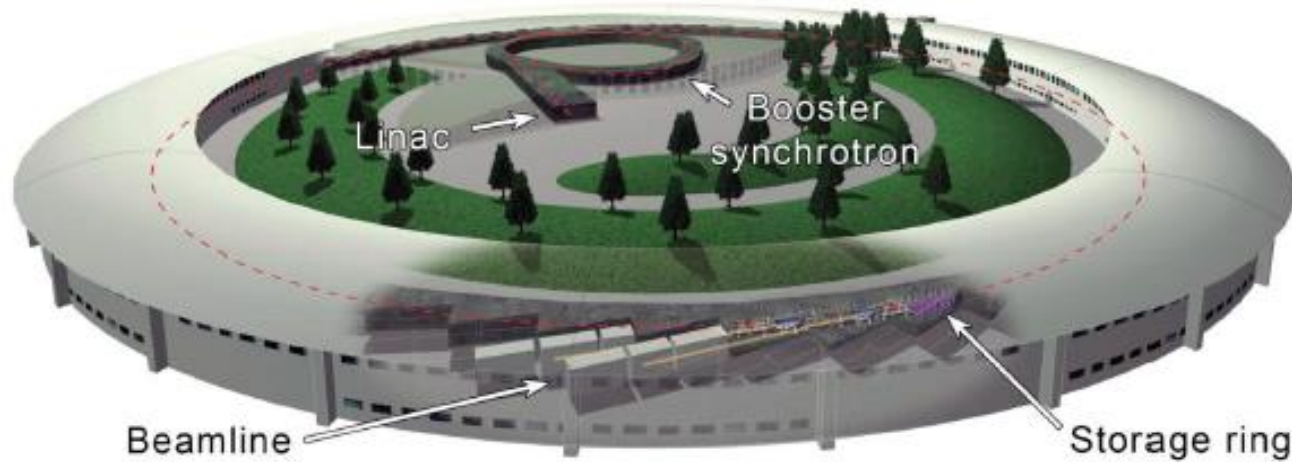
Africa is now on a
roadmap towards an
African Light Source

Graphic adapted from ESRF source

The African Light Source Project

What is a Light Source (synchrotron / FEL) transformative scientific instruments similar to the invention of conventional lasers and computers ...
premier research tool for

- Bio science, materials science, geo science, paleontology, archeology, environmental science, energy science, chemistry, industry



The African Light Source Project

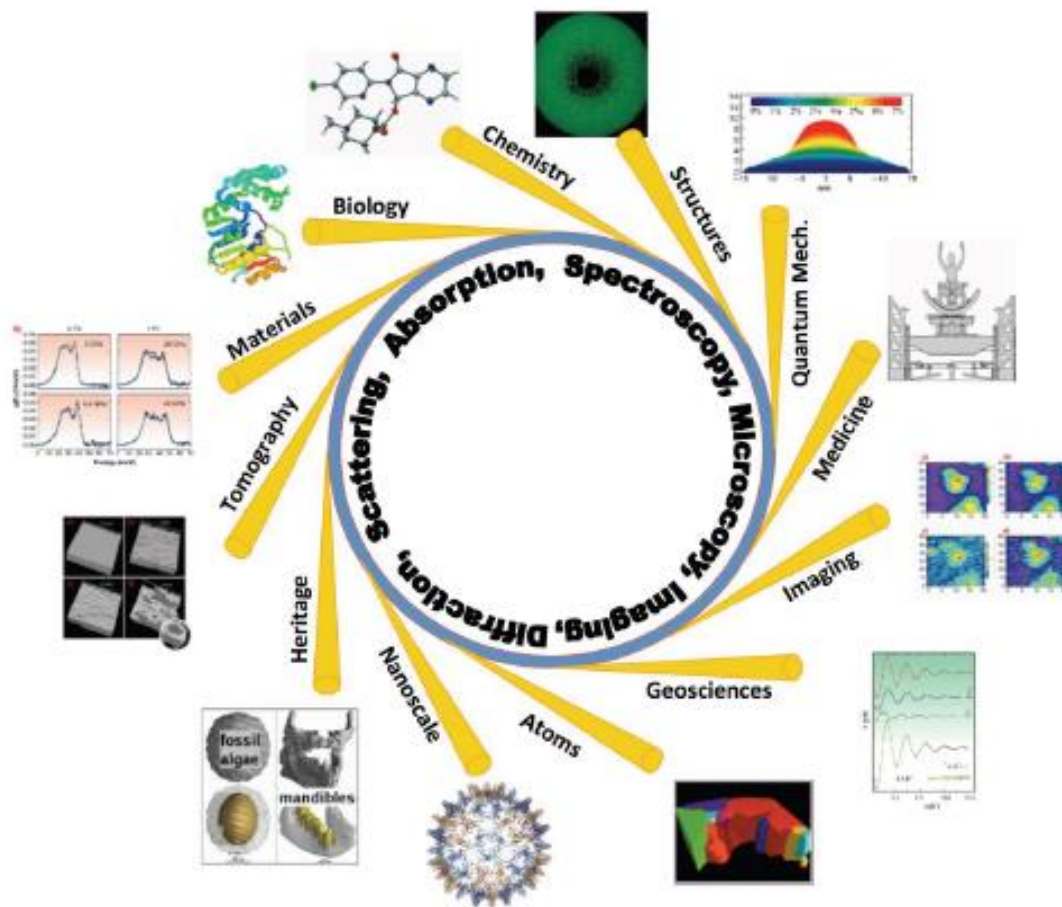


Some examples of Science with Synchrotrons

Multidisciplinary

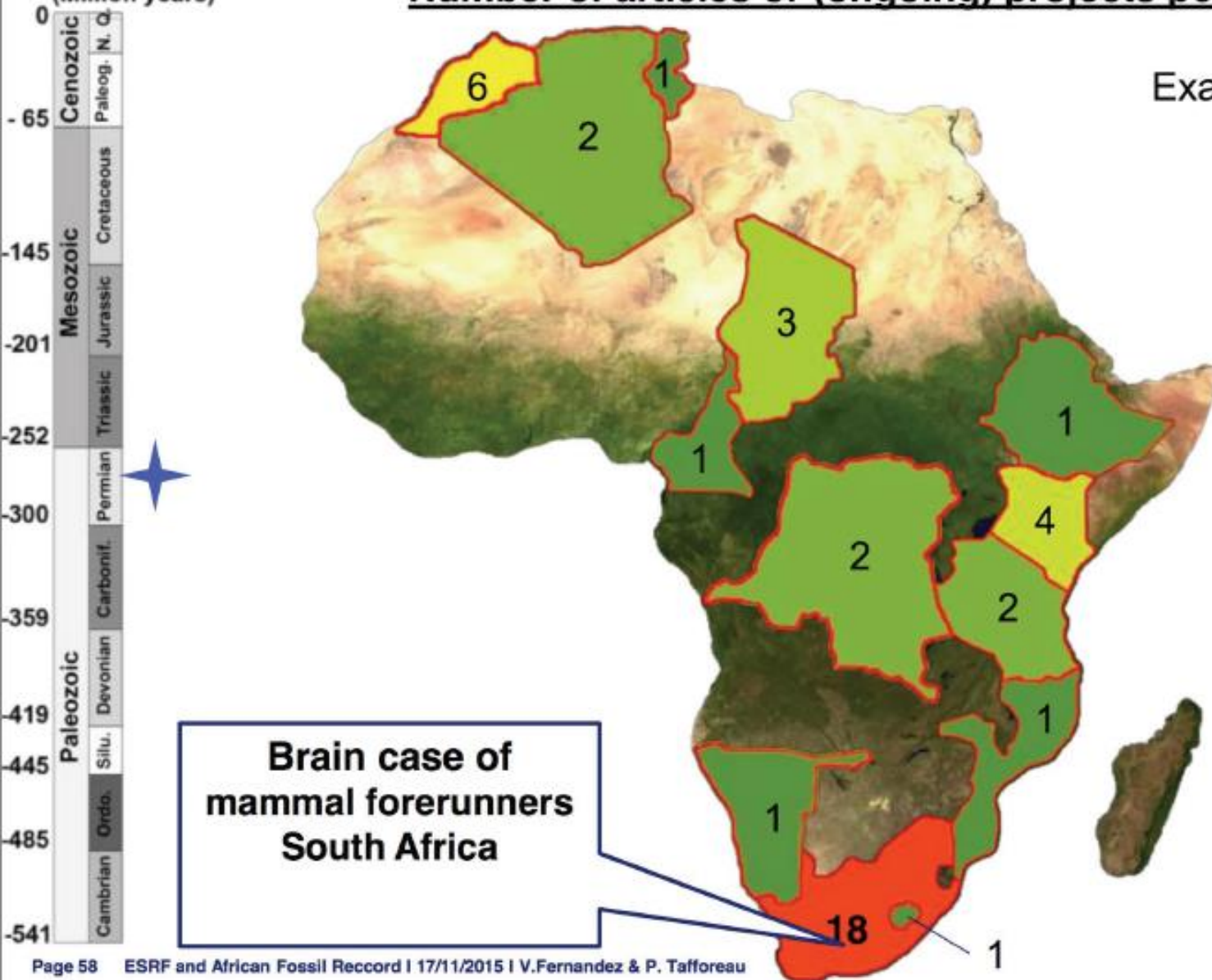
- Research
- Technology
- Industry

* Credit inferred from each slide



Age
(Million years)

Number of articles or (ongoing) projects per country



Example of ongoing projects

**Brain case of
mammal forerunners
South Africa**

African School of Fundamental Physics and Applications



The students progress successfully.

Where are the students now?

..... For some ... The African Science Diaspora



Beyond Capacity Building



The East African Institute of Fundamental Research

An ICTP Partner Institute in Rwanda

The EAIER is situated on the Kigali campus of the University of Rwanda (UR).

- 30 to 50 or more MSc students
- PhD programme to be determined
- 5 research scientists
- Ultimately 15 postdoctoral fellows
- Hub for visiting scientists.
- Networking opportunity for students
- ~ 5 scientific meetings / schools a year
- Collaboration with the ICTP



- All aspects of EAIER are based on scientific merit with a positive bias to gender equality and geographical distribution.
- Expected to act as a node for various physics networks in Africa.
- Potential opportunity for Capacity Building groups to partner and engage in a plan of Beyond Capacity Building

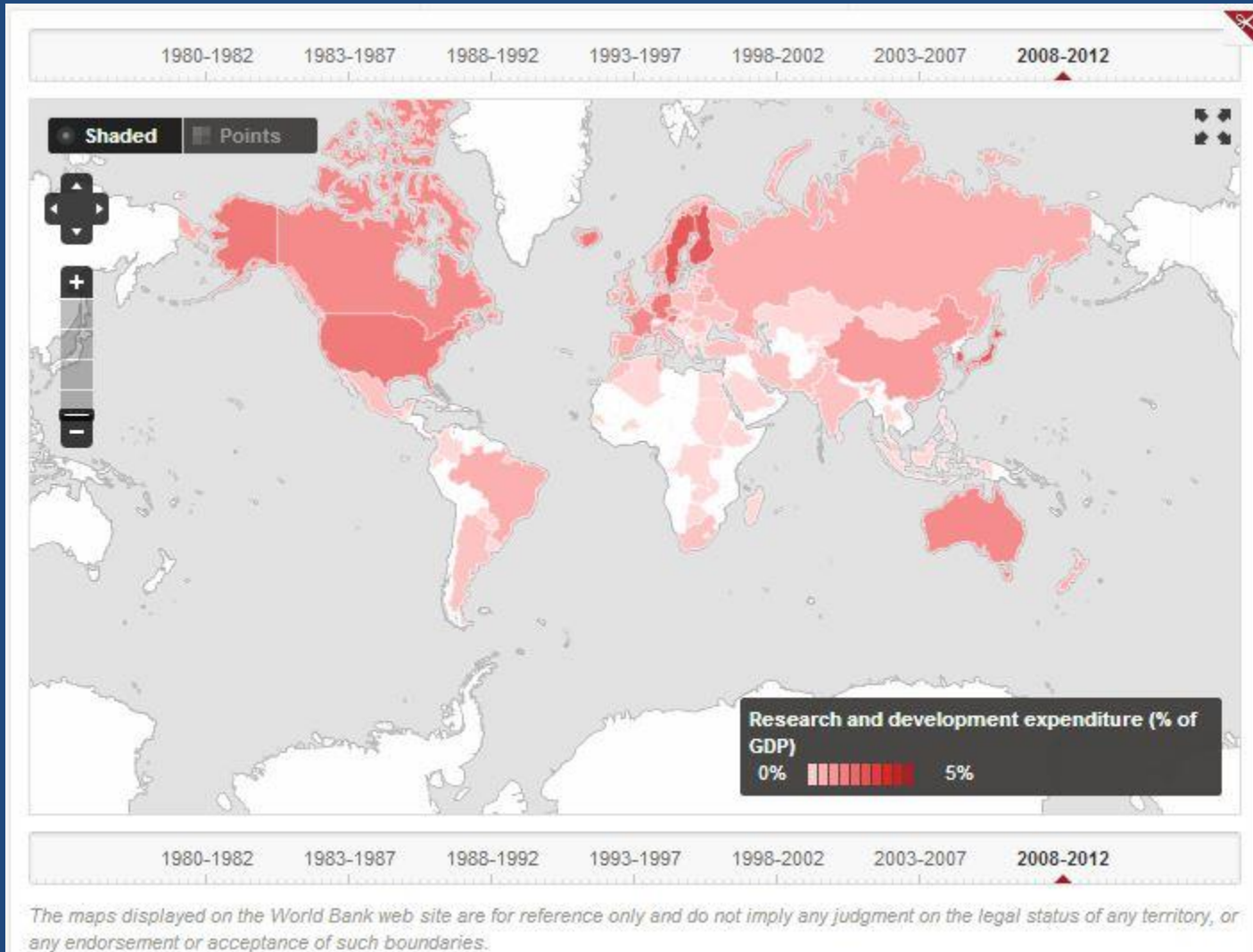
SCIENCE, TECHNOLOGY AND INNOVATION STRATEGY FOR AFRICA

2024

(STISA-2024)

- **10 year Science, Technology and Innovation Strategy for Africa**
- **Adopted by the African Union Heads of State and Government Summit in 2014**
- **AU Agenda 2063**

Research & Development Expenditure as % GDP [Source: World Bank]



Gross Domestic Expenditure on R & D of selected countries
(Source: African Innovation Outlook, 2010)

Country	Year	GERD as % GDP
Botswana	2005	0.52
Burkina Faso	2009	0.2
Ethiopia	2010	0.24
Ghana	2008	0.47
Kenya	2007	0.42
Malawi	2007	1.70
Mozambique	2010	0.47
Namibia	2005	0.3
Nigeria	2007	0.22
Senegal	2008	0.37
South Africa	2010/2011	0.76
Tanzania	2007	0.48
Uganda	2009	0.41
Zambia	2008	0.34
Zimbabwe	2005	0.2

Dependency on Foreign Funding for R & D in 2010 (%) in Selected SSA Countries

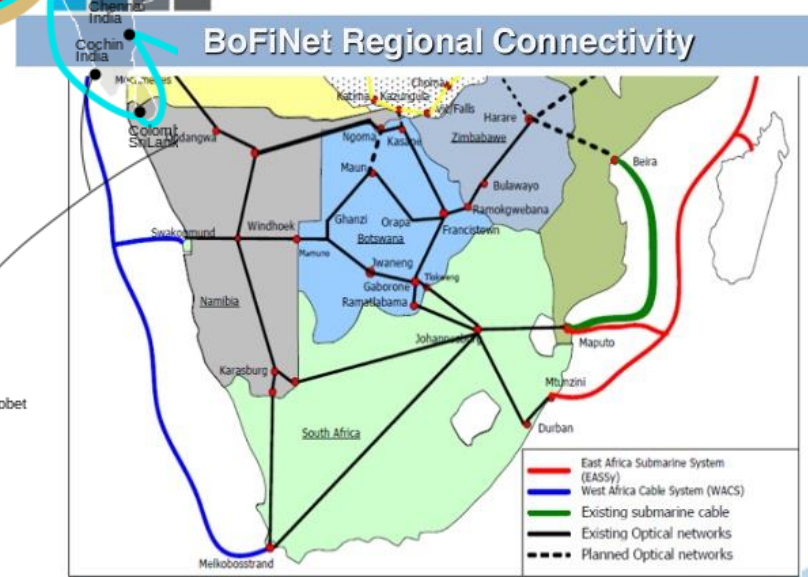
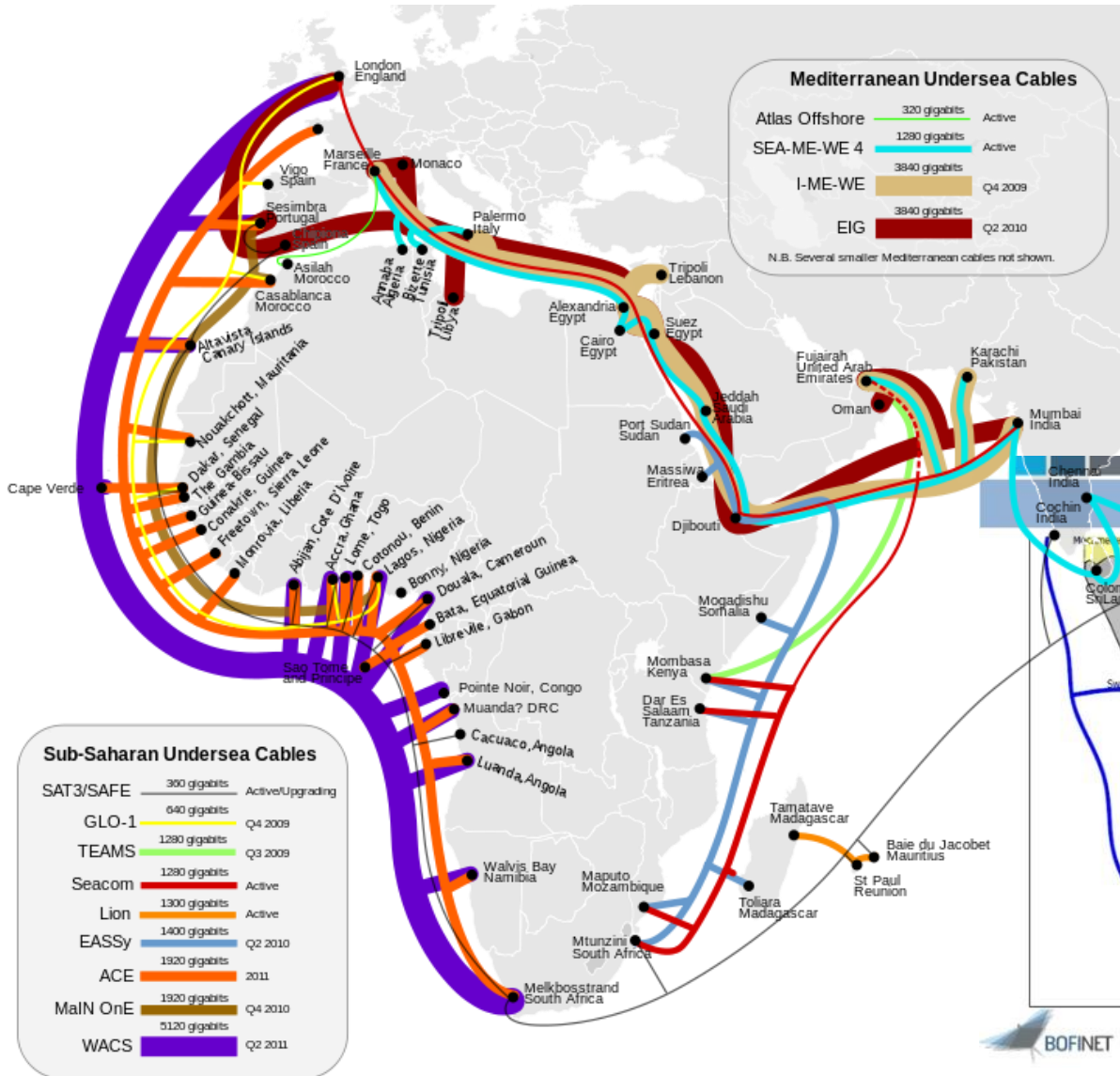
(Source: African Innovation Outlook, 2010)

Country	Funds from abroad
Ghana	11.9
Kenya	17.6
Malawi	33.1
Mozambique	57.3
Nigeria	1.0
Senegal	38.3
South Africa	10.7
Tanzania	38.4
Uganda	12.8
Zambia	1.7

Research & Development Expenditure as % GDP [Source: World Bank]

Rank ↕	Country/Region ↕	Expenditures on R&D (billions of US\$, PPP) ↕	% of GDP PPP ▾	Year ↕	Source ↕
18	 Israel	9.4	4.2%	2011	[2]
5	 South Korea	55.8	3.74%	2011	[4]
3	 Japan	160.3	3.67%	2011	[4]
16	 Sweden	11.9	3.3%	2011	[2]
25	 Finland	6.3	3.1%	2011	[2]
1	 United States	405.3	2.7%	2011	[2]
19	 Austria	8.3	2.5%	2011	[2]
27	 Denmark	5.1	2.4%	2011	[2]
4	 Germany	69.5	2.3%	2011	[2]
13	 Taiwan	19.0	2.3%	2011	[2]
20	 Switzerland	7.5	2.3%	2011	[2]
60	 Iceland	0.3	2.3%	2011	[2]
26	 Singapore	6.3	2.2%	2011	[2]
2	 China	296.8	1.97%	2012	[3]

Continental, Regional and National Connectivity



Albert Einstein

“Imagination is more important than knowledge”

“Logic can take you from point A to B, imagination can take you anywhere”

“We cannot solve our problems by using the same thinking we used to create them”

Stephen Hawking

“Intelligence is the ability to adapt to change”

Way forward

- **The need for enhanced coordination of existing scientific interventions**
- **Responsive to critical areas of human endeavor**
- **Regular assessment of the impact of existing scientific interventions**
- **The need to go beyond capacity building**
- **Active involvement of African key stakeholders**
- **Structural reforms**
- **Well coordinated African efforts aimed at acceleration of meaningful scientific development**
- **Increased African investment in scientific development**
- **Better funding of African universities**
- **Establishment of the African evaluation and monitoring committee**



Thank You