


The changing face of South African science

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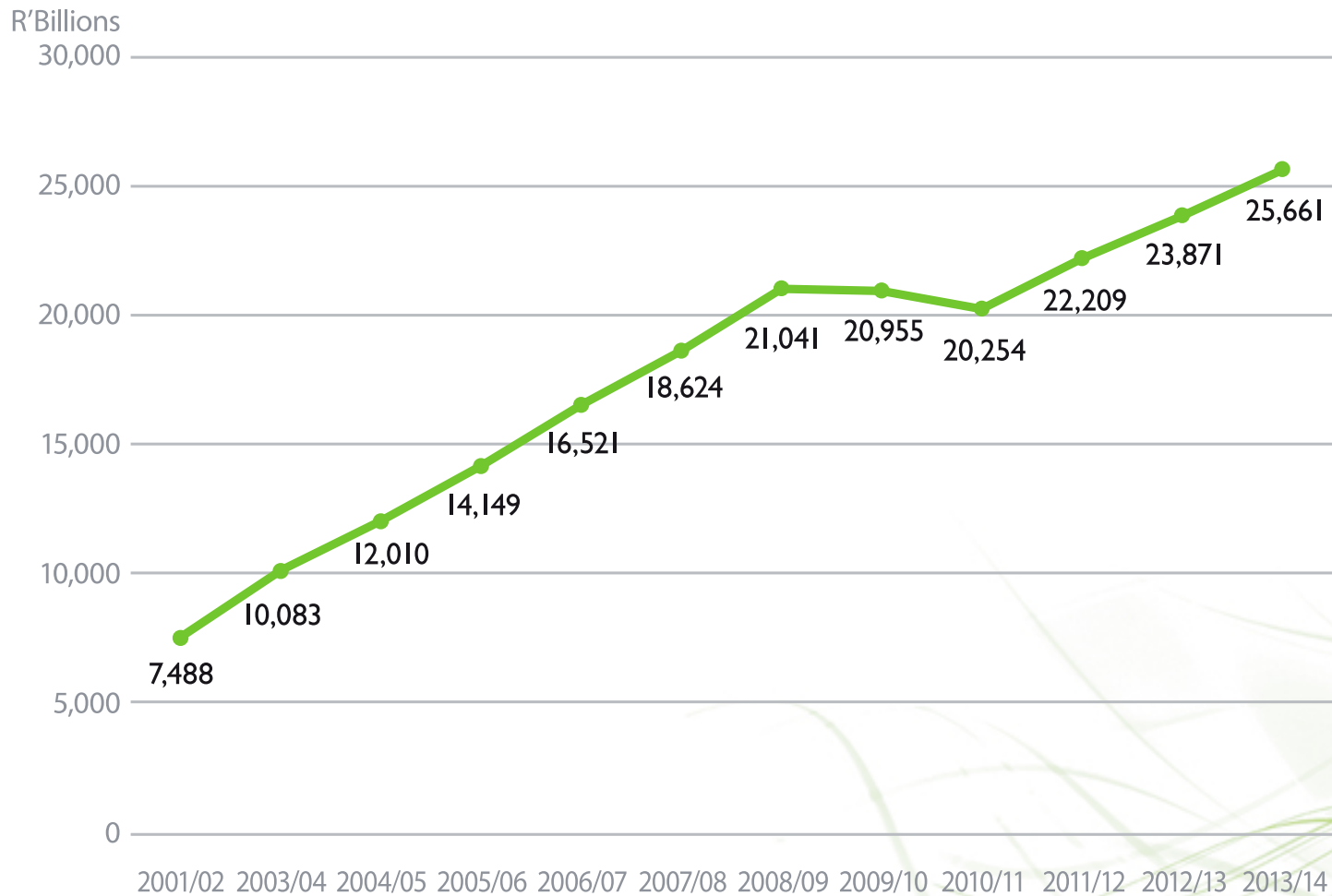
Investment in science

The background is a solid light green color. Overlaid on this are several thin, white, curved lines that flow across the page, creating a sense of movement and depth. These lines vary in thickness and curvature, some appearing as simple arcs while others are more complex, overlapping patterns.

Investment in SA science - Assessment

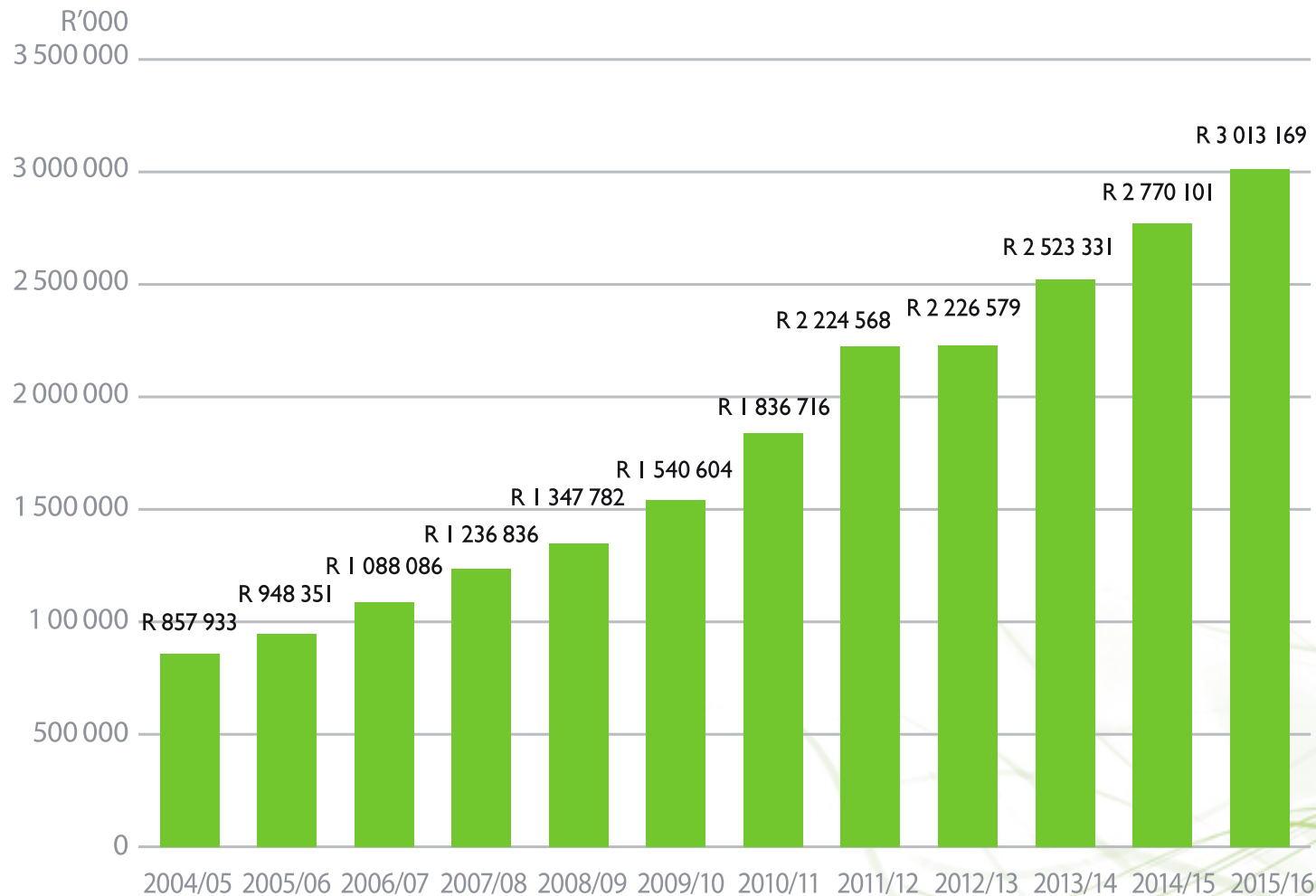
- The historical trend data show that GERD as a percentage of GDP in South Africa increased from 0.60% in 1997/98 and peaked at 0.95% in 2006/07. Since then, the R&D expenditure in nominal Rand value has increased, but not at the same rate as the growth in GDP. As a result, the indicator has displayed a relative decline since 2007/08, and no change between 2010/11 and 2013/14 (0.76%)
- The past two decades have seen the introduction of more directing funding instruments
 - Performance-funding for University knowledge production
 - Steering of science through NRF funding instruments

R&D expenditure in nominal rand value (2001 to 2014)



Data source: SA R&D survey (2013/14 – Statistical Report)

Total research output grant awarded by DHET (2005 to 2016)



Data source: DHET

Directed funding from the NRF (2005 to 2015)

Thrip funding	R 1,495 million
Women in research	R 46 million
Thutuka	R 69 Million
Funding for basic science: Unlocking the future	R 192 Million
Established researchers	R 404 million
CoE funding	R 330 Million
SARChI funding	R 994 Million
National equipment	R 448 Million

Investment in SA science – The challenge

- The goal of achieving 1.5% of GDP in R&D needs to be actively pursued
- A detailed analysis of current data-gathering methodologies of the investment in SA science needs to be undertaken
- Attention must be given to proper monitoring and assessment of performance-based funding instruments to ensure quality and optimal impact

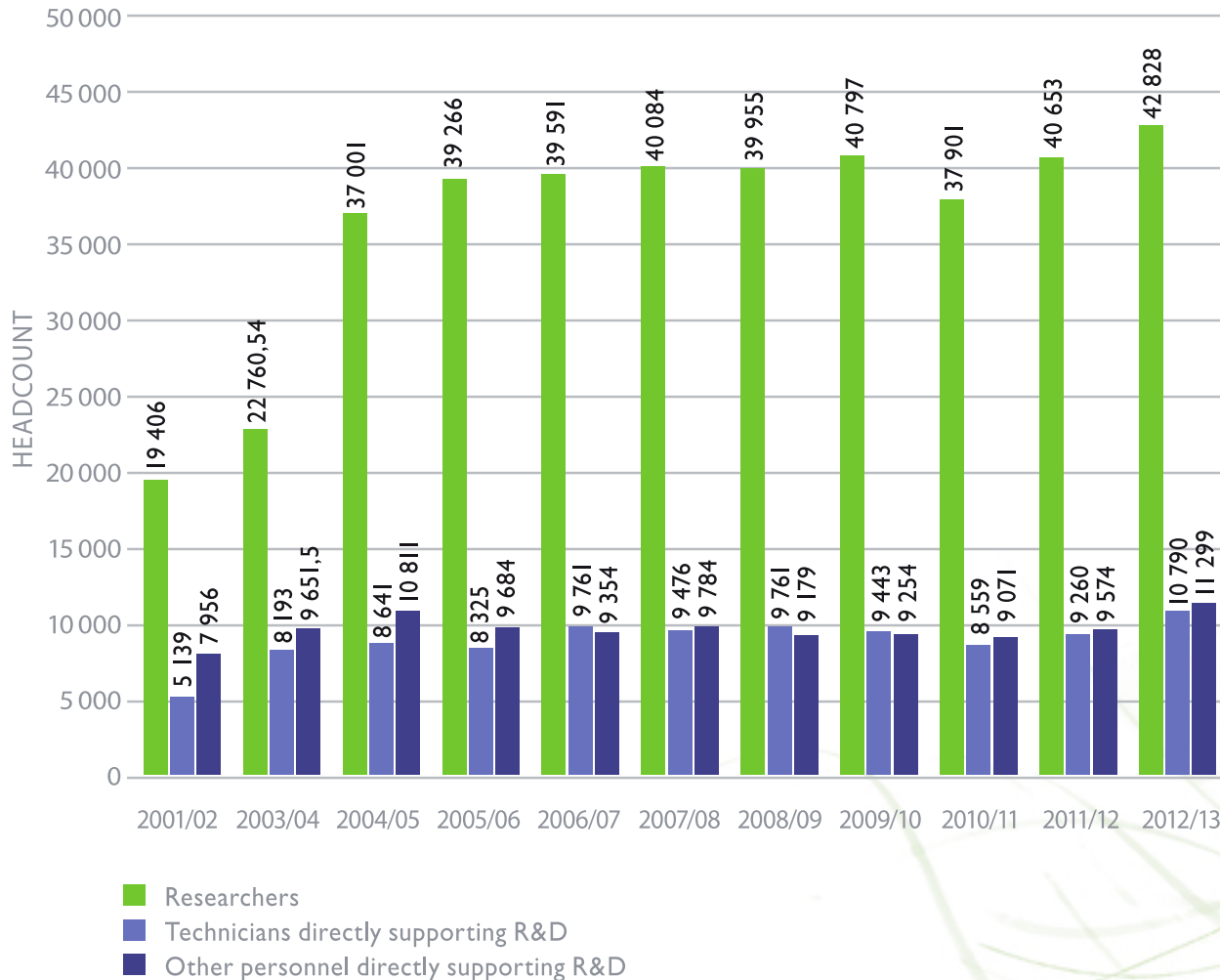
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Human resources for Science and Technology

Human resources for S&T – An assessment

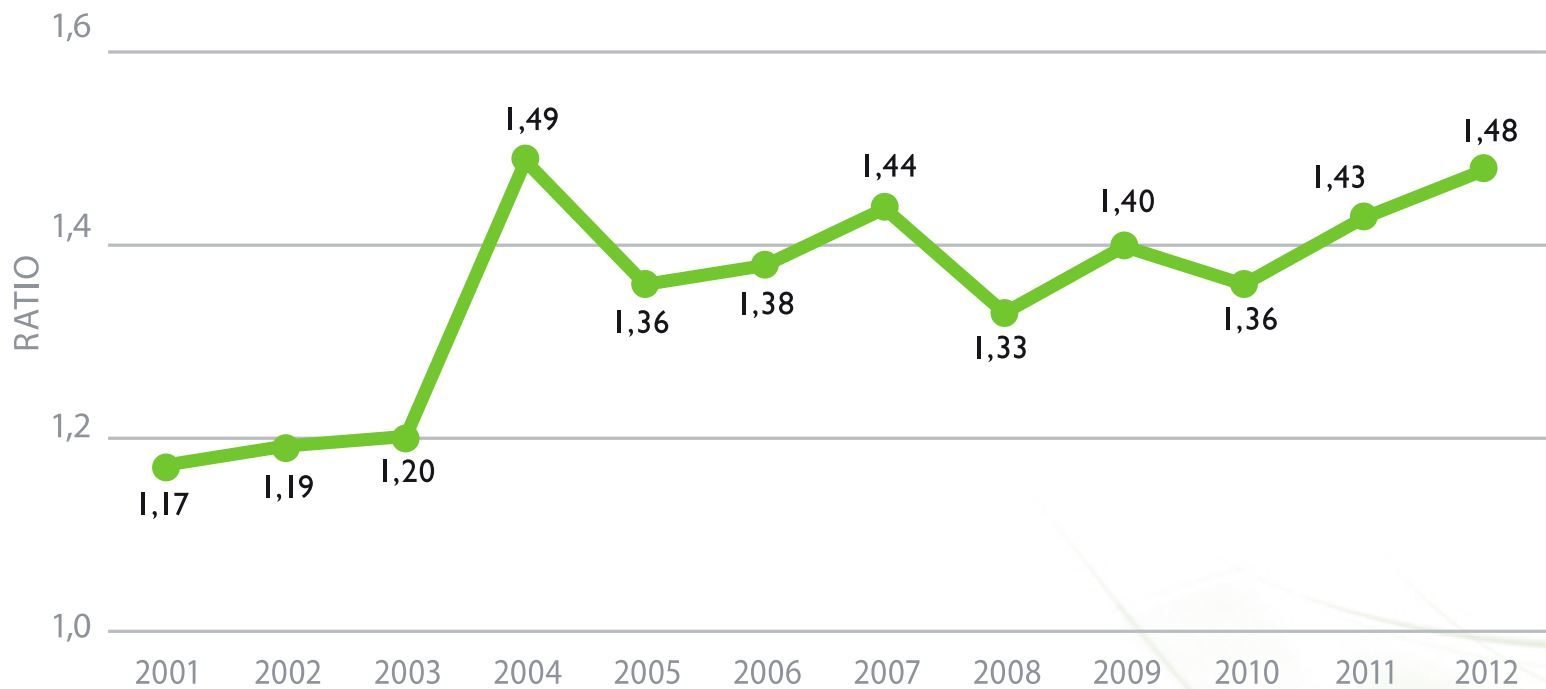
- We have witnessed nearly zero growth in the expansion of the human resource capacity for S&T in the country over the past two decades
- However, the pool of future scientists and academics (through sustained increases in PG students and post-doctoral fellows) has expanded. But there are two caveats: the in-migration of doctoral candidates from other African countries has been the main source of the growth in PG student numbers; the growth in international post-doctoral fellows has been confined to specific disciplines only

R&D personnel (headcount) by occupation (2001 to 2013)



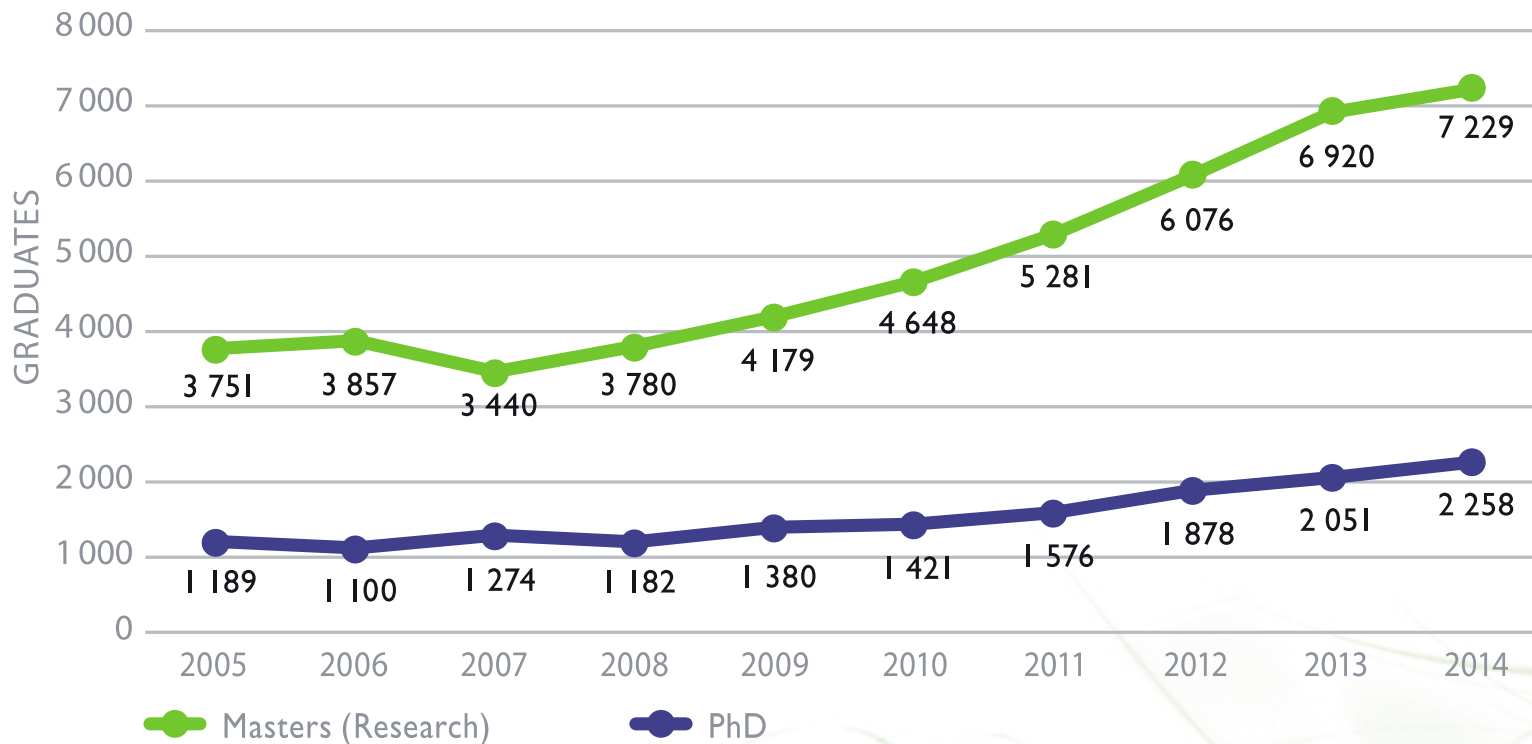
Data source: R&D Survey data

Total number of researchers per 1 000 employed (2001 to 2012)



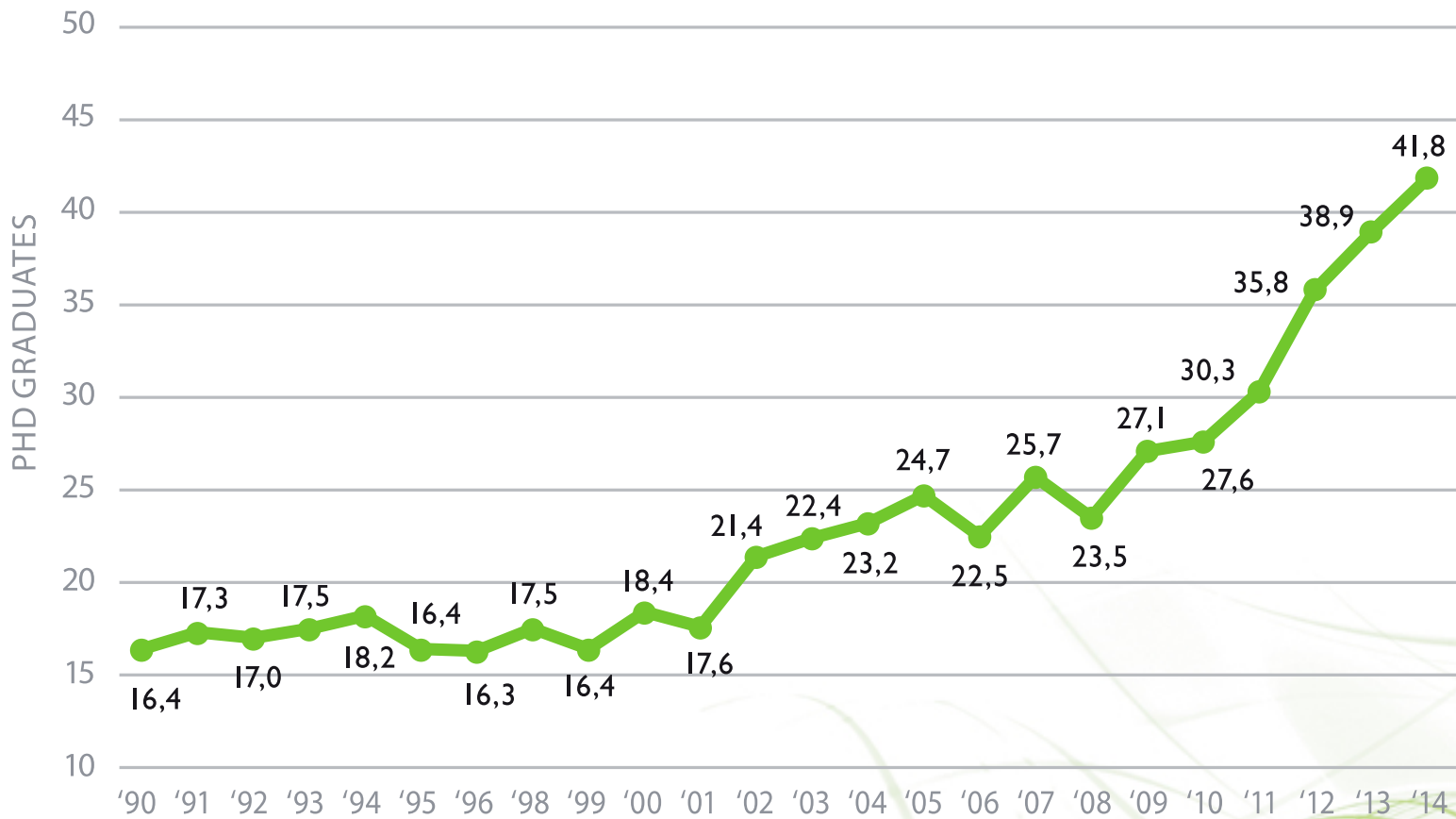
Data source: OECD (2015), Researchers (indicator). doi: 10.1787/20ddfb0f-en
(Accessed on 02 April 2015)

Number of research masters and PhD graduates (2005 to 2014)



Data source: HEMIS

PhD graduates per million of population (1990 to 2014)



Data source: HEMIS

Human resources for S&T – The challenge

- Unless we expand the science and innovation system, the supply of doctoral candidates may soon overtake the demand (currently most doctoral graduates still find employment in the labour market)
- We need to design and implement more interventions that would ensure the increased participation of young black South Africans in the higher education and science system

**SA's scientific production: Output,
impact and collaboration**

SA's scientific production: World share and impact – An assessment

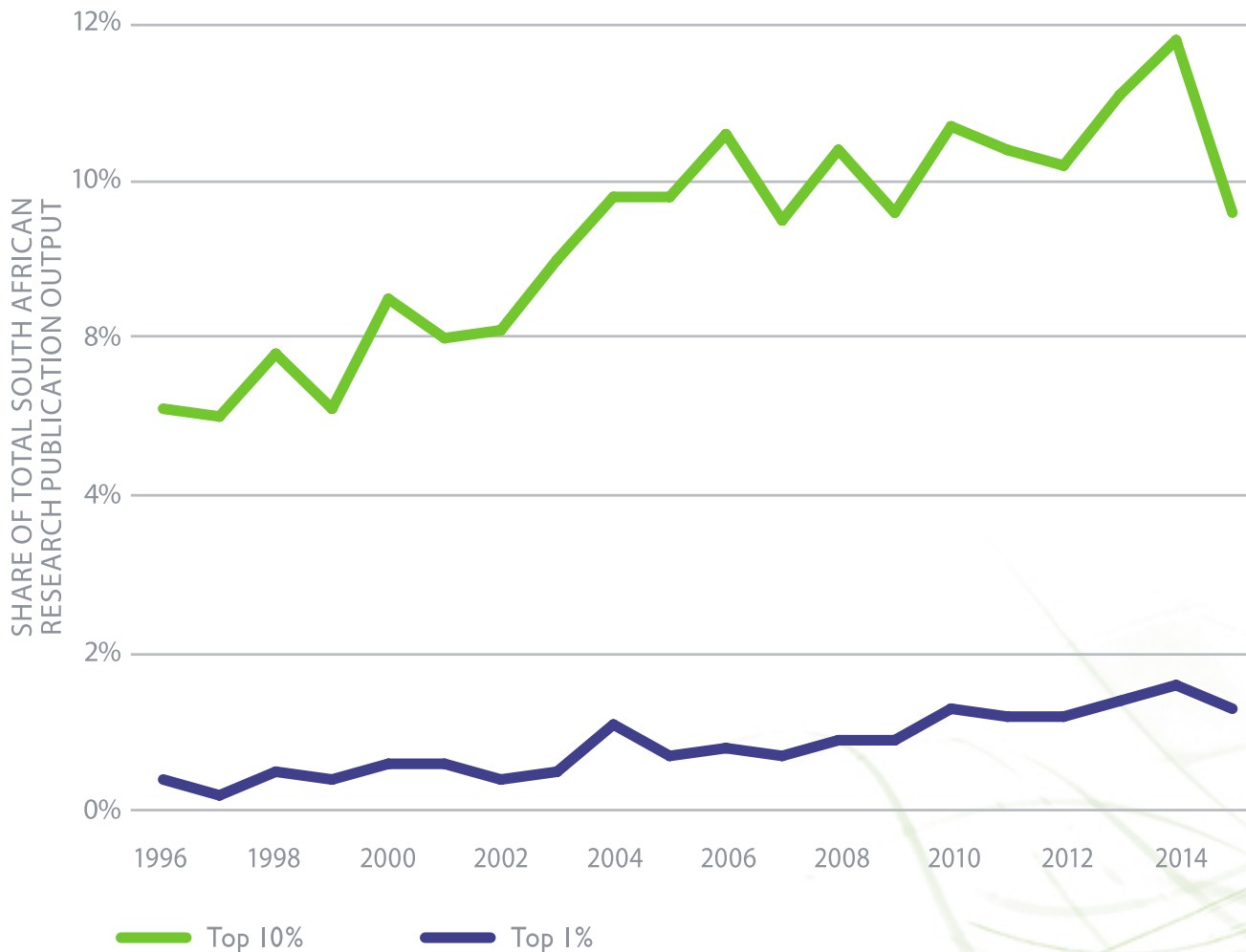
- Across all disciplines SA's share of world science amounts to 0.6% for the period 1996 to 2015. Some disciplines are better represented (e.g. SA publications in the social sciences and humanities constitute 1% of all world papers).
- As for the collective citation impact of all those publications together, South Africa's field-normalised citation impact has gone up very gradually from 0.66, the 4-year citation-window 1996-1999, to an impact score of 1.03 for the period 2011-2014. Keeping in mind that a score of 1.00 on this performance indicator represents world average citation impact, SA has moved up from a performance level 'below par' to 'international level' in less than two decades.

Share of South African science in global science – in total and by discipline (1996 to 2015)

	Share of South African research publications in ...		
	world publication output	top 10% cited worldwide	top 1% cited worldwide
All fields in total	0.6%	7.1%	0.6%
Medical and life sciences	0.6%	6.8%	0.7%
Natural sciences	0.5%	8.6%	0.7%
Engineering sciences	0.4%	7.8%	0.5%
Social and behavioural sciences	1.0%	4.0%	0.2%
Arts, humanities and law	1.1%	9.7%	1.2%
Language and communication	1.0%	3.5%	0.1%

Data source: CWTS Thomson Reuters Web of Science database (whole counting; research articles and letters)

Annual trends in SA's share of highly cited publications (1996 to 2014)

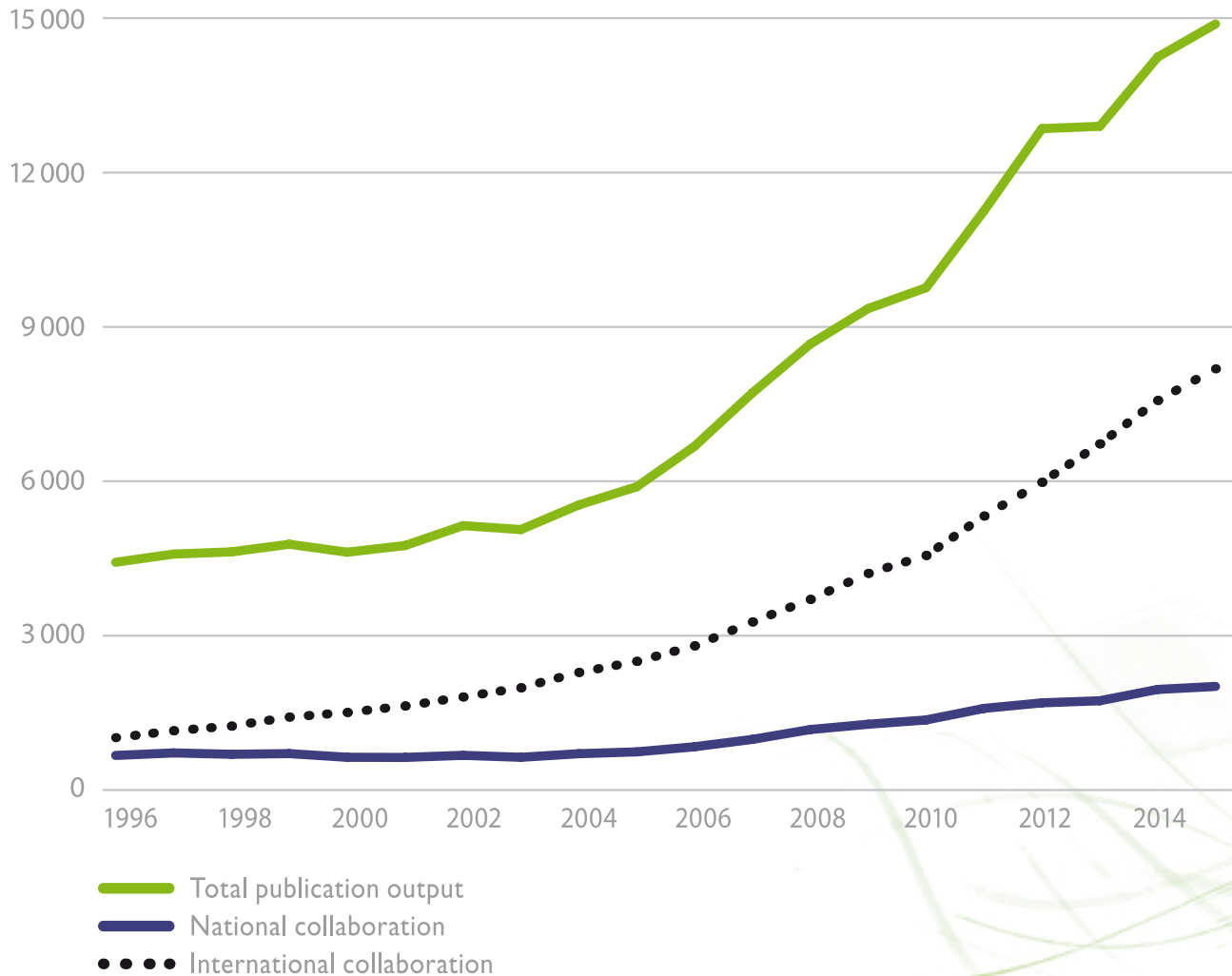


Data source: CWTS Thomson Reuters Web of Science database (whole counting; research articles and letters)

SA's scientific production: Output and collaboration – An assessment

- South Africa's total publication output in the TR Web of Science more than tripled between 1996 and 2015. It grew by 240%, with an average annual increase of 6.6%. The main driving force of the growth was international collaboration: these outputs increased by 710%.
- Research publications arising from domestic collaboration grew by 200%, whereas those produced by a single organisation lagged behind and increased by a 'mere' 70%. International collaboration is boosting South Africa's research performance at the global level. SA's collaboration with African scientists also increased over this period with a substantive AAG of 22.3%

Annual trends in SA's scientific publication output (WoS)



Data source: CWTS Thomson Reuters Web of Science database (whole counting; research articles and letters)

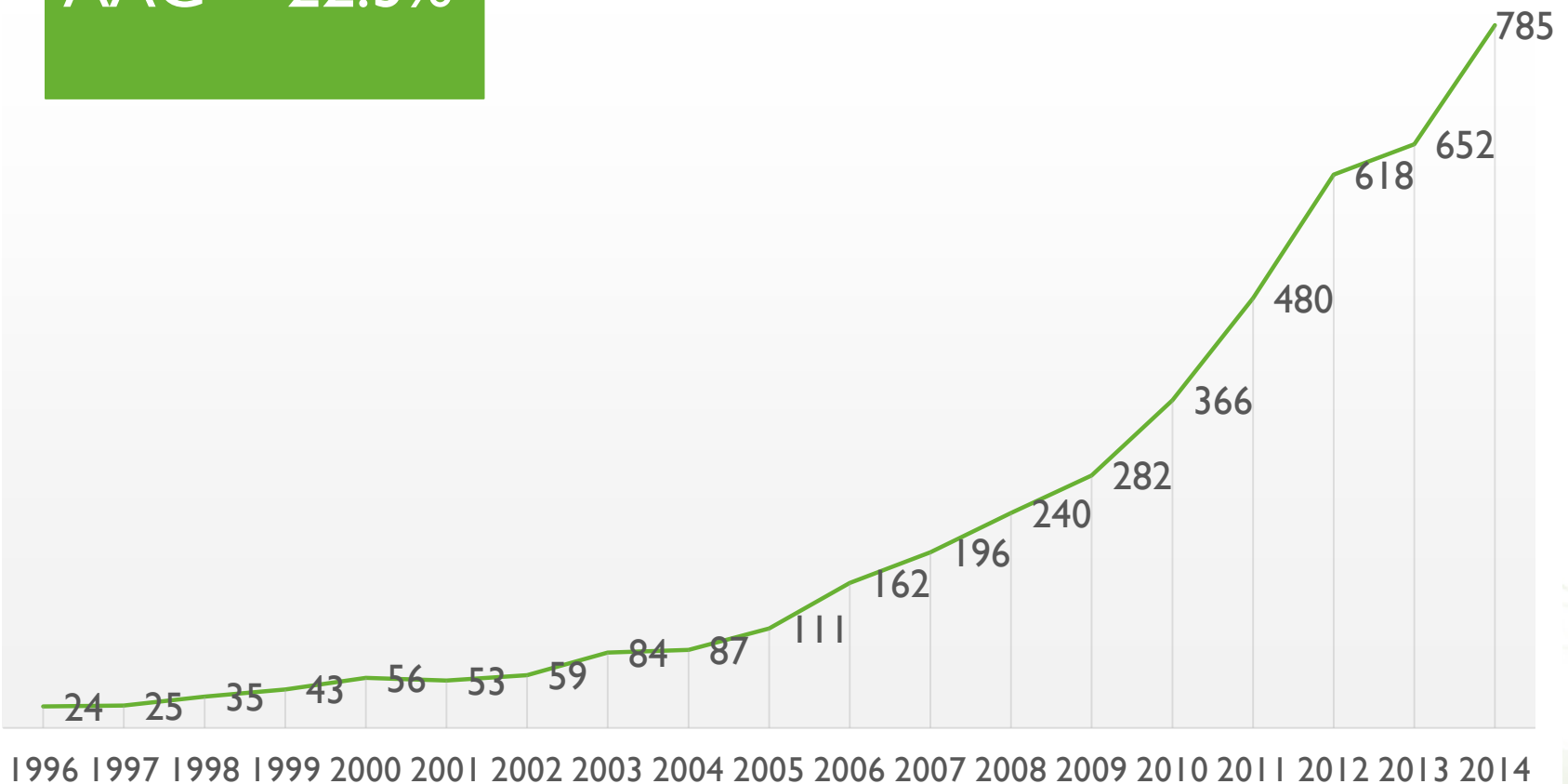
Growth rates of SA's publication output

	% total growth rate	% compound annual growth rate
All	240	6.6
International collaboration	710	11.6
National collaboration	200	6.0
Single organisation	70	2.9

Data source: CWTS Thomson Reuters Web of Science database (whole counting; research articles and letters)

Significant increase in SA collaboration with Africa

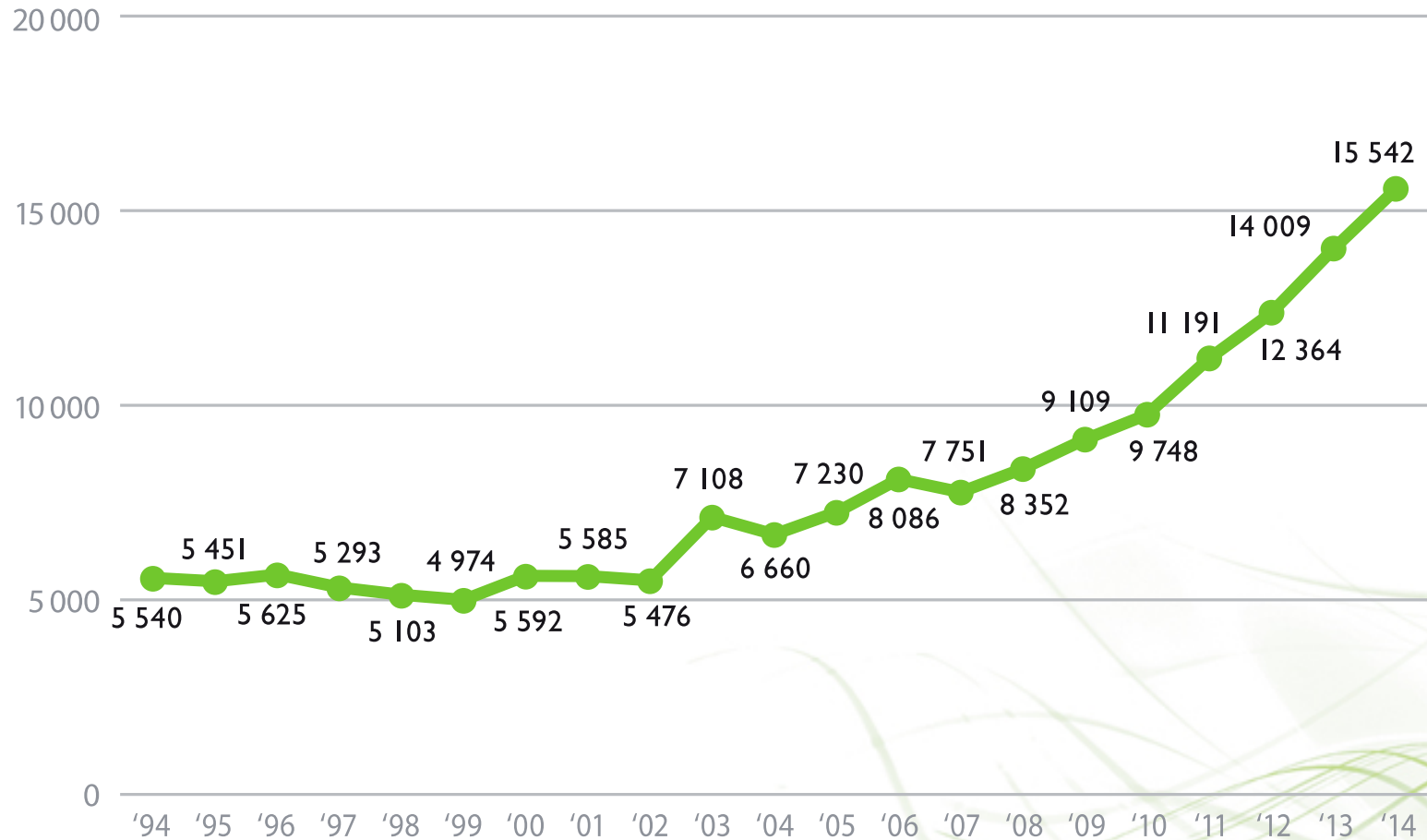
AAG = 22.3%



SA university output: Growth and productivity – An assessment

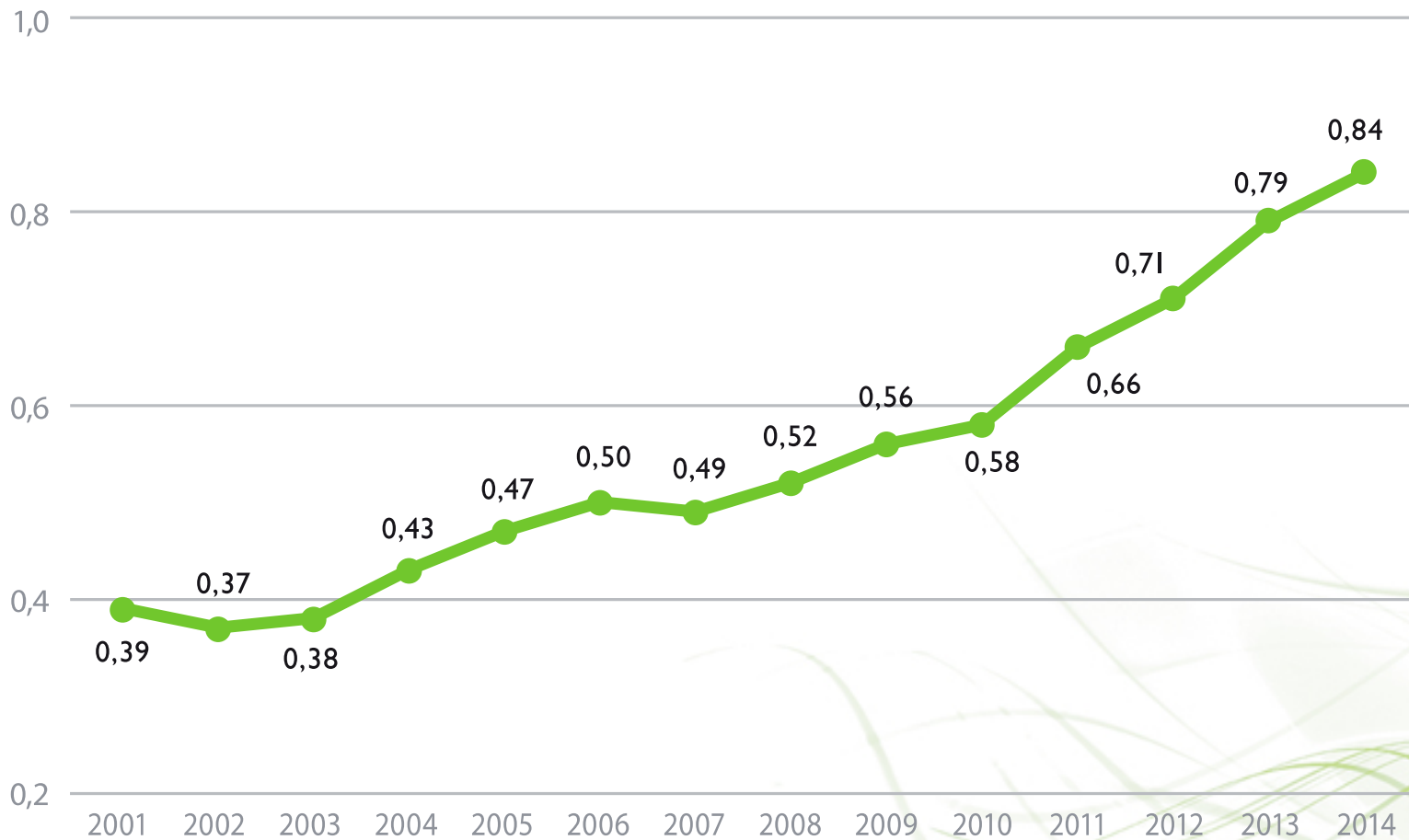
- The production of books, book chapters, conference proceedings and journal articles at SA universities has increased substantially (from 6 660 in 2004 to 15 542 in 2014). This increase translates into an average annual growth rate for the past ten years of 8.8%.
- Whilst we have witnessed this substantial growth in output, the human resource base at SA universities has not grown commensurately. The average annual growth in headcount of academic staff has only grown by 2.9% per annum. This has resulted in a substantial increase in the capita research productivity of SA academics.

Research publications produced by SA universities (1994 to 2014; fractional counts)



Data source: SA Knowledgebase, CREST

Per capita research output at SA universities (2001 to 2014)



Data source: DHET

SA 's scientific production – The challenge

- The substantial increases in output, impact and international collaboration are laudable, but more directed incentives need to be considered to ensure that these trends are maintained
- However, there are increasing signs that this growth has come at the expense of a loss of quality and even increasing evidence of “questionable” publication practices. It is, therefore, imperative that appropriate quality assurance mechanisms are put in place to ensure the highest integrity of SA scholarly publishing

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Demographics of South African science production

Demographics of SA science – An assessment

As far as gender and race of author are concerned we have been successful in creating a more representative and inclusive human resource base for South African science over the past twenty years. As far as age of author is concerned, the very steep increase in the number of publishing authors over the age of 50 that was recorded between 1990 and 1998 (from 18% to 45%) seems to have stabilized. In 2005 this proportion was 42% and in 2014 very similar at 45%. Conversely the proportions of publishing scientists in the youngest age category has not increased significantly.

Headline demographics

	1990	1998	2014
% of scientific papers published by female authors	10%	20%	32%
% of scientific papers published by black authors	3.5%	10%	32%
% of scientific papers published by authors above the age of 50	18%	45%	45%

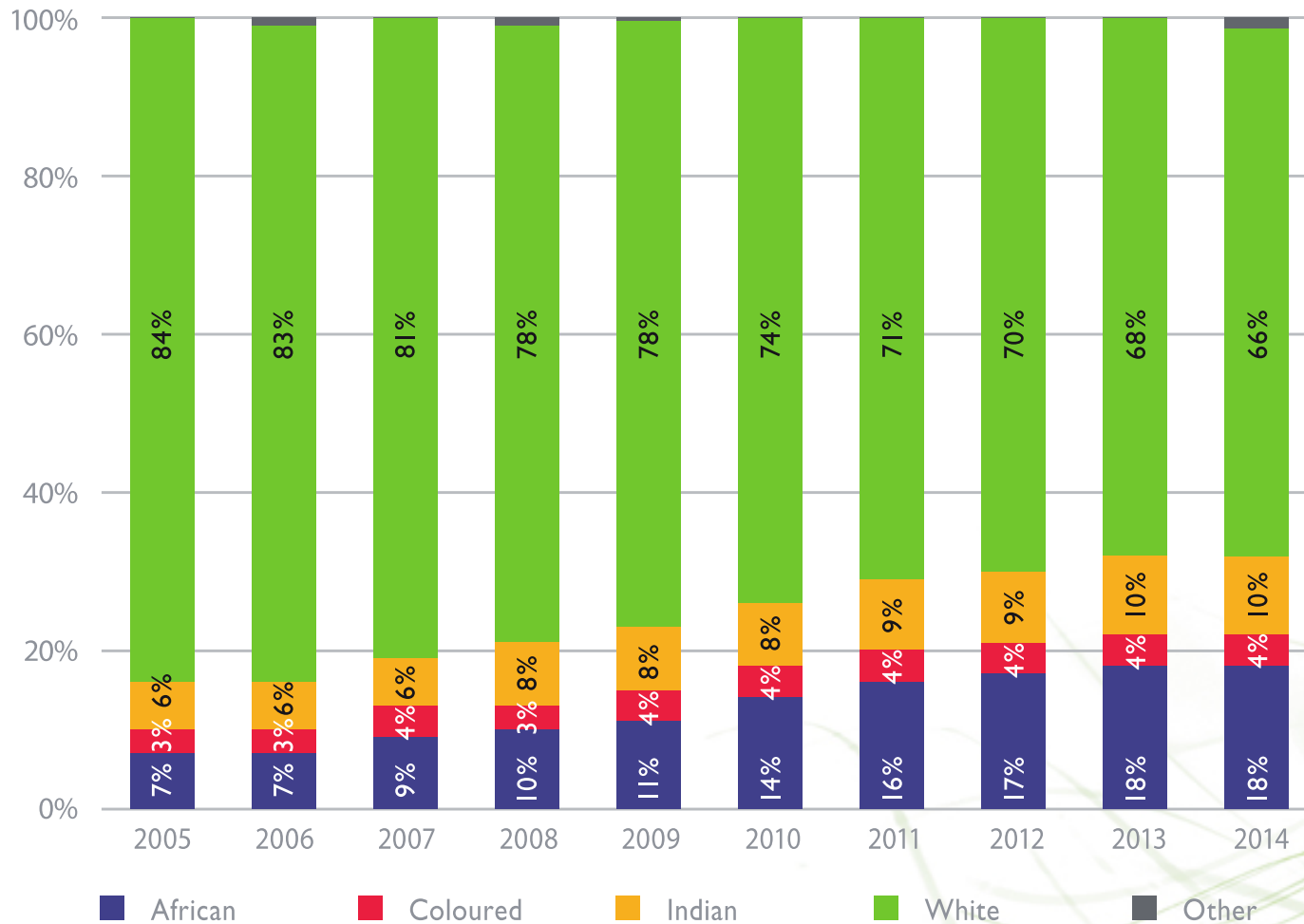
Data source: SA Knowledgebase

Gender of authors of scientific papers (2005 – 2014)



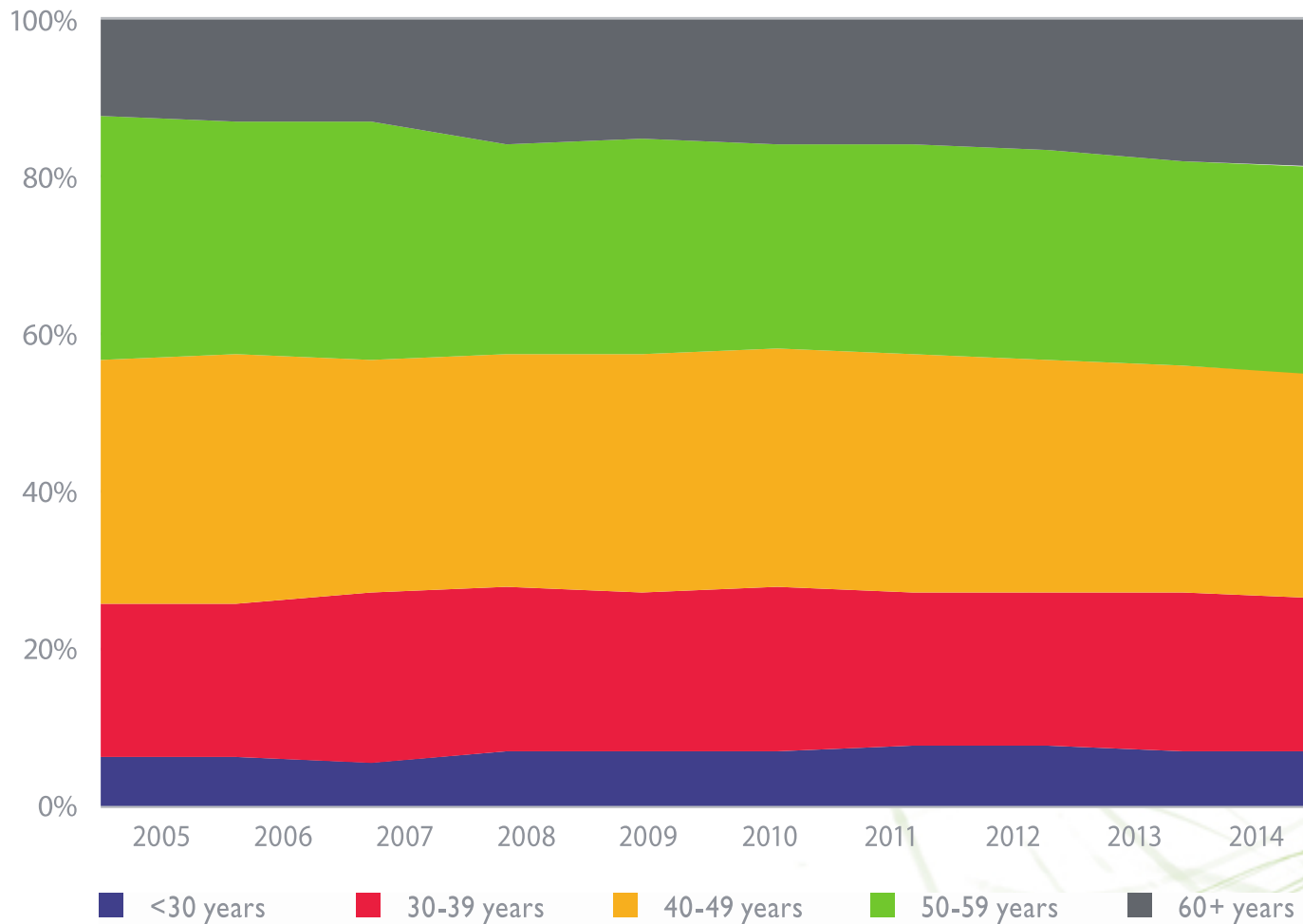
Data source: SA Knowledgebase

Race of authors of scientific papers (2005 – 2014)



Data source: SA Knowledgebase

Age at publication of authors of scientific papers (2005 – 2014)




Data source: SA Knowledgebase

The demographics of SA 's scientific production

– The challenge

The shifts to a more inclusive science system evidently needs to be sustained. This would suggest that directed efforts at achieving such targets are effective despite the lack of growth in the overall capacity of the system. The latter probably explains why we are still not attracting sufficient numbers of younger cohorts of scientists. Efforts to do so need to be accelerated.



General conclusions

The last 20 years have seen the South African science system rise to an international level as our collaboration and interactions with other scientists in the rest of the world, as well as in Africa, continues to grow and enhance its many contributions to society. There are still big challenges ahead: the investment in R&D needs to increase, the human resource base for S&T needs to be expanded, and the transformation of the science base needs to continue to become even more representative of the SA nation.

General conclusions

But at the same time, we have shown remarkable increases in productivity and efficiency in the production of research publications and post-graduate students, our contribution to world science and the steady rise in our citation impact. Huge investments have been made in strengthening the research infrastructure of the country through, amongst others, the implementation of the centres of excellence and research chairs programmes.

Our challenge is to continue to create new initiatives and mechanisms to ensure that the good reputation SA science internationally is nourished and, of course, valued amongst our own citizens.



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Thank you
