CSIR strategic and annual performance plan for 2018/19

A presentation to the Parliamentary Portfolio Committee on Science and Technology

25 April 2018

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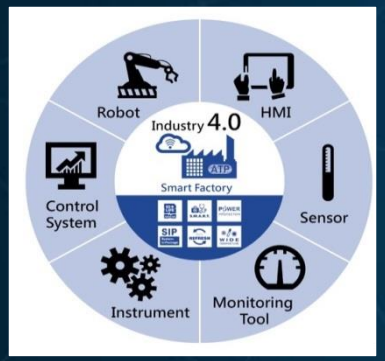
Strictly confidential

Contextual considerations



- **Human capital**
  - **National:** Need for job creation against a changing production environment (manual vs automated, mechanisation, augmentation, service industry growth vs manufacturing industry decline)
  - **CSIR:** Retention of existing SET base challenging in current fiscal environment. Will need to build industry relevant capacity – industrial, design and system engineers, digital implementation and integration experts etc.
- **Financial environment**
  - **Slow SA economic growth, decreasing investment in R&D:** Presents risk to CSIR financial sustainability. Affects required investments for infrastructure renewal
  - **Continued de-industrialisation:** Opportunity to increase economic growth through innovation-led industrialisation
  - **African economy:** Clear opportunity for SA to be the (innovation) leader in the African "renaissance"
  - **CSIR:** Tapering growth trajectory, difficulty in contracting with state-owned entities and government departments
- **Technology landscape**
  - **New industrial paradigm (Industry 4.0):** Digital integration, sensor fusion, decentralisation, customisation, increased opportunities and prevalence of smaller companies and tech-based SMMEs
  - **DST White Paper on STI:** Increased focus on innovation environment

Presentation outline

OUR MANDATE

EXTERNAL AND INTERNAL CONTEXT

STRATEGIC OBJECTIVES

- Build and transform human capital
- Conduct high-quality research to foster scientific development
- Conduct relevant research to foster industrial development
- Infrastructure renewal and development
- Financial sustainability and governance

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Our mandate

CSIR MANDATE

"The objects of the CSIR are, through **directed** and **particularly multi-disciplinary research** and **technological innovation**, to foster, in the national interest and in fields which in its opinion should receive preference, **industrial** and **scientific development**, either by itself or in **co-operation with principals** from the **private** or **public sectors**, and thereby to contribute to the **improvement of the quality of life** of the people of the Republic, and to perform any other functions that may be assigned to the CSIR by or under this Act."

(Scientific Research Council Act 46 of 1988, amended by Act 71 of 1990)

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External context

- **SA economy:** Slow growth, deindustrialisation, unfavourable credit ratings, rising unemployment, decline in competitiveness, declining investor confidence
- **Fiscal constraints:** Increasing demands on the fiscus, constrained national budgets, competing priorities such as free education, debt servicing costs
- **Private sector investment in R&D:** Limited growth in investment, need for a new CSIR value proposition to stimulate investment
- **Skills:** Increased competition for scarce skills
- **Industry 4.0 and digitalisation:** Enabling economies to achieve more with less, associated entrepreneurial opportunities
- **Future workforce:** Changing skills landscape in South Africa
- **Science and technology white paper:** Opportunities to contribute to innovation-led economic development – aligned with the CSIR mandate
- **Africa on the rise:** Opportunities created by growth in Africa

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Internal context

- **Limited growth:** Flattening growth trajectory requires new positioning of the CSIR
- **Consolidation:** Consolidation required in line with changes in external context and implementation of strategic repositioning
- **Organisational strategy**: An in-depth look at organisational strategy resulting from the need to amplify the CSIR focus on industrial development – assessing innovation programme, skills and capabilities, organisational architecture and operations
- **Human capital:** Challenges in SET base attraction and retention
- **Financial sustainability:** Reliance on public sector investment, regulations leading to challenges in contracting with national government institutions and state-owned entities
- **Operational efficiency:** Improving organisational processes, accountability, efficiencies
- **Infrastructure:** Lack of recapitalisation, configuration of infrastructure to align with strategic direction

A research and development focus shaped by national priorities

FOCUS OF OUR RESEARCH

The National Development Plan – Vision 2030

Building a capable state
Economy and employment
Transforming human settlements
Low-carbon economy
Improving health
Economic and social infrastructure
Building safer communities

The National Nine-Point Plan

Resolving the energy challenge
Revitalising agriculture/agro-processing
Adding value to mineral wealth
Higher Industrial Policy Action Plan
Private-sector investment
Unlocking the potential of SMMEs, rural enterprises
Infrastructure interventions: ICT, water, sanitation & transport
Operation Phakisa

DST Strategic Plan: 2015-2020

A knowledge-based economy
Knowledge to enhance industrialisation
Knowledge to increase economic efficiency

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Strategic objectives

Build and transform human capital	2018/19	• Accelerated researcher development in designated groups • Leadership development • Development of human capital strategy • Staff engagement
Conduct high-quality research to foster scientific development	2018/19	• Developing an integrated water research centre • Setting up the National Integrated Cyberinfrastructure System • Positioning the CSIR to be a player in block-chain technologies
Conduct relevant research to foster industrial development	2018/19	• Strengthening the CSIR's skills in Industry 4.0 • Strengthening our industrial development capabilities in bio-chemical conversions • Technologies to support a vibrant supply chain in high-value manufacturing • Technologies to support inclusive industrial development
Infrastructure renewal and development	2018/19	• Energy-autonomous campus • Campus Master Plan
Financial sustainability and good governance	2018/19	• Achieve 5.5% growth in total income • Maintain good governance record • Embed safety improvement plan

STRATEGIC OBJECTIVE 1

Build and transform human capital

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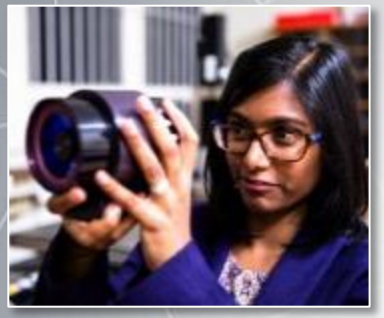
Context



- CSIR committed to building and transforming human capital
- Support growth of SET base in line with national objectives
- CSIR financial sustainability has direct impact on continued SET base growth
- Increasing demand for senior researchers and PhDs across multiple sectors has increased the staff turnover for CSIR to an average of 10.3%pa
- Good progress made in the attraction of black SET base and PhD candidates - supporting transformation at middle and senior management levels
- Number of females in SET base remains a challenge
- 182 promotions, with 3 promoted to chief researcher level
- 369 postgraduates supported through DST-funded interbursary programmes
- 164 beneficiaries on CSIR Bursary Programme

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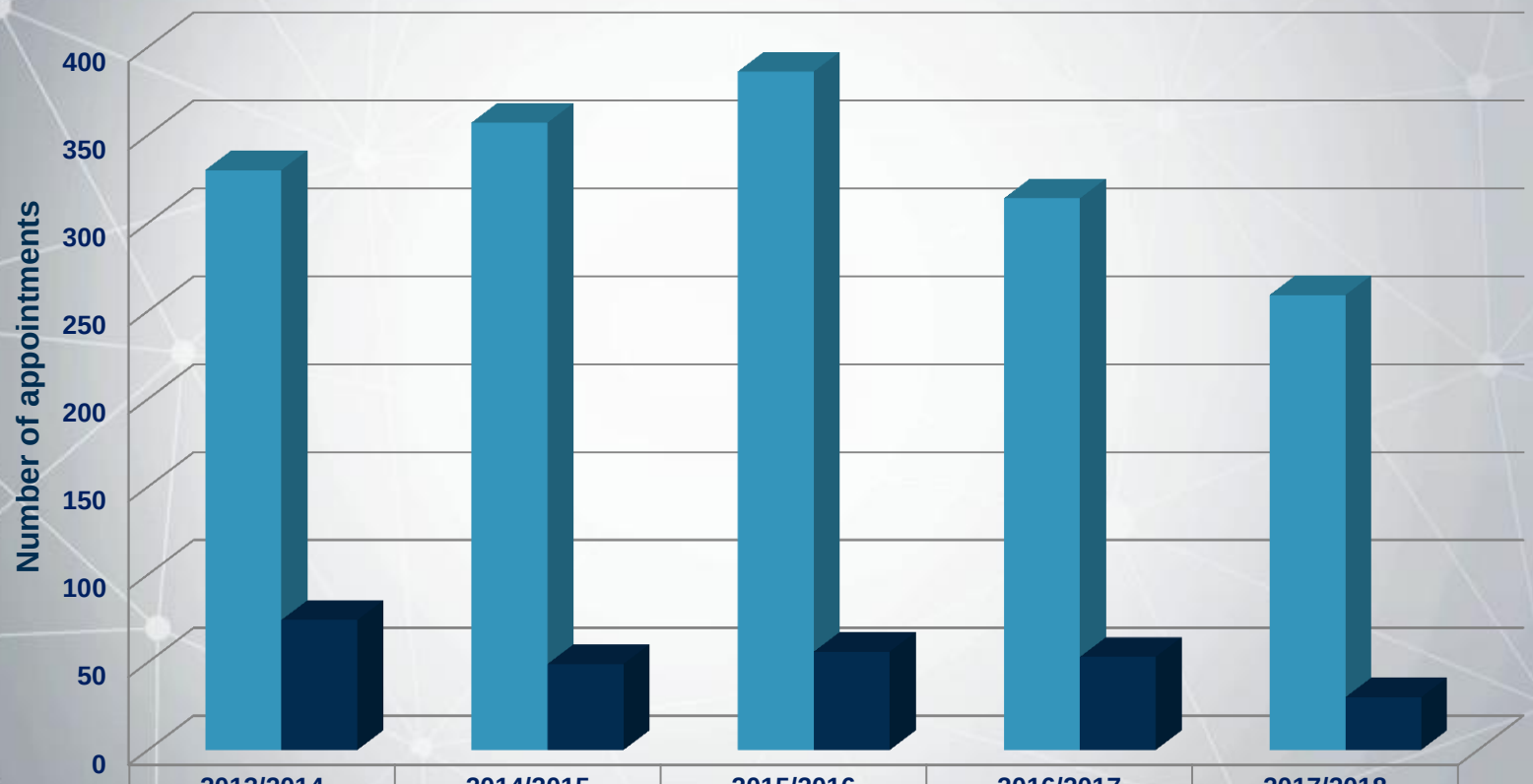
Human capital development
Trend in recruitment from 2013 to date

Trend in staff appointments



	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018
Black	330	357	386	314	259
White	74	49	56	53	30

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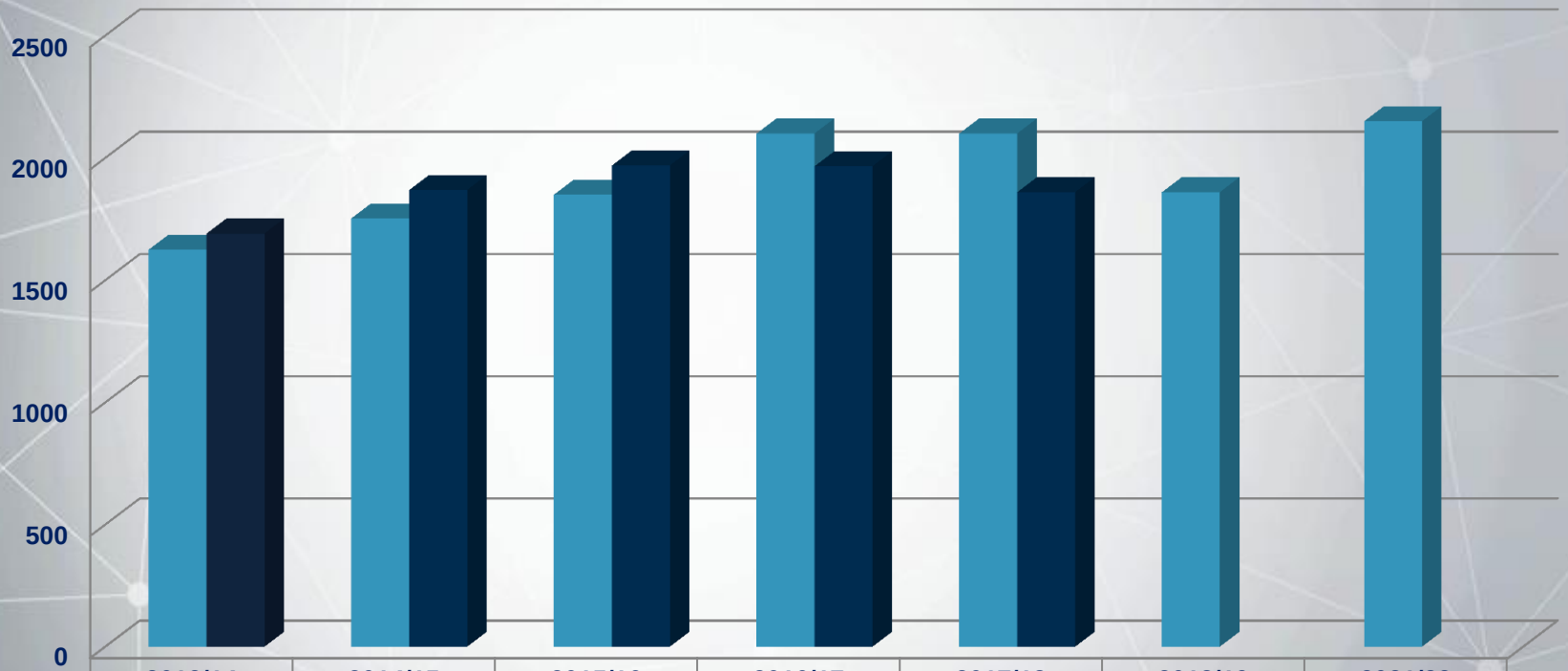
Key performance indicators
SET staff numbers



	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2021/22
Target	1625	1753	1850	2100	2100	1860	2150
Projected	1691	1869	1969	1966	1860		

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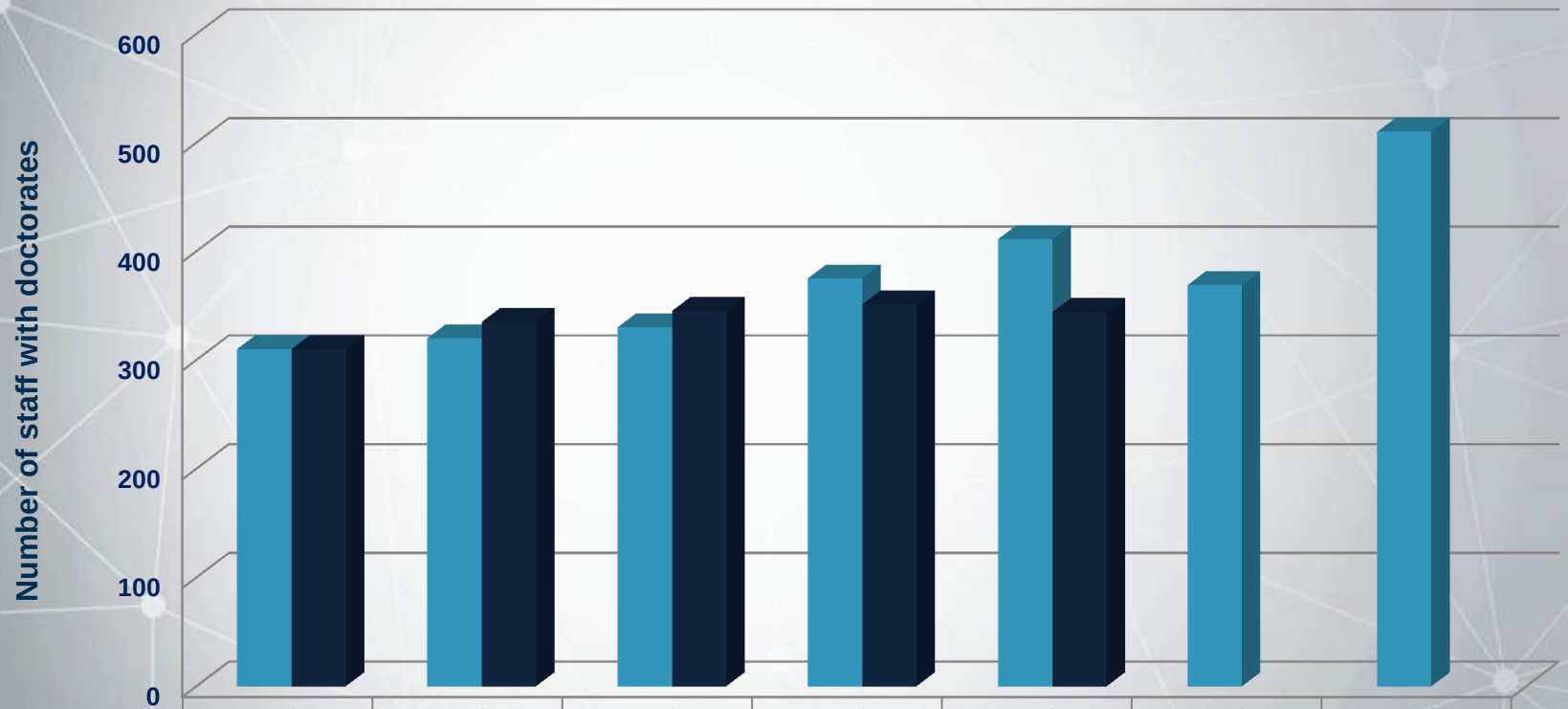
Key performance indicators
Number of doctorates

Trend in number of doctorates



	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2021/22
Target	310	320	330	375	411	369	510
Projected	310	335	345	351	344		

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Key performance indicators
Build and transform human capital

Indicator	Actual 2016/17	Target 2017/18	Projected 2017/18	Target 2018/19
Total size of SET base	1 966	2 100	1 860	1 860
Number of Blacks in SET base	1 190	1 280	1 160	1 160
% of Blacks in SET base	61%	61%	62%	62%
Number of females in SET base	702	785	687	687
% of females in SET base	36%	37%	37%	37%
Number of PhDs in SET base	351	411	344	369
% of PhDs in SET base	18%	20%	18%	20%

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Key performance indicators
Build and transform human capital

Indicator	Actual 2016/17	Target 2017/18	Projected 2017/18	Target 2018/19
Total: Chief researchers	20	22	21	23
Number of Black Chief Researchers	1	2	2	3
% of Black Chief Researchers	10%	9%	10%	13%
Number of female Chief Researchers	3	4	4	3
% of female Chief Researchers	15%	18%	19%	13%
Total: Principal researchers	228	240	205	210
Number of Black Principal Researchers	48	53	51	57
% of Black Principal Researchers	21%	22%	25%	27%
Number female Principal Researchers	42%	45	37	41
% of female Principal Researchers	18%	19%	18%	20%

2018/19 Key priorities
Human capital development

- Maintain SET base - ensure a healthy undergraduate pipeline in critical areas
- Improve qualification profile of SET base - support MSc and PhD students
- Prioritise transformation of SET base - support designated groups
- Review HCD strategy to reflect changing approach to industry
- Implement staff engagement programmes
- Researcher acceleration and pipeline development programme
- Engage in strategic partnerships for human capital development
- Implement revised career ladder

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STRATEGIC OBJECTIVE 2

Conduct high-quality research to foster scientific development

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Context

- Review the R&D portfolio to align with Project Synapse and consolidate resources
- Establish new research areas in line with global trends and national needs
- Leverage partnerships to maximise resource-use efficiency, relevance and uptake
- Position the CSIR as a key partner in research and innovation in the African context
- Review the patent portfolio to maximise returns

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Key performance indicators
Research for scientific development

Indicator	Actual 2016/17	Target: 2017/18	Projected 2017/18	Target: 2018/19
Publication equivalents	491	500	500	480
Journal articles	286	310	310	310
New patents	15	15	15	15

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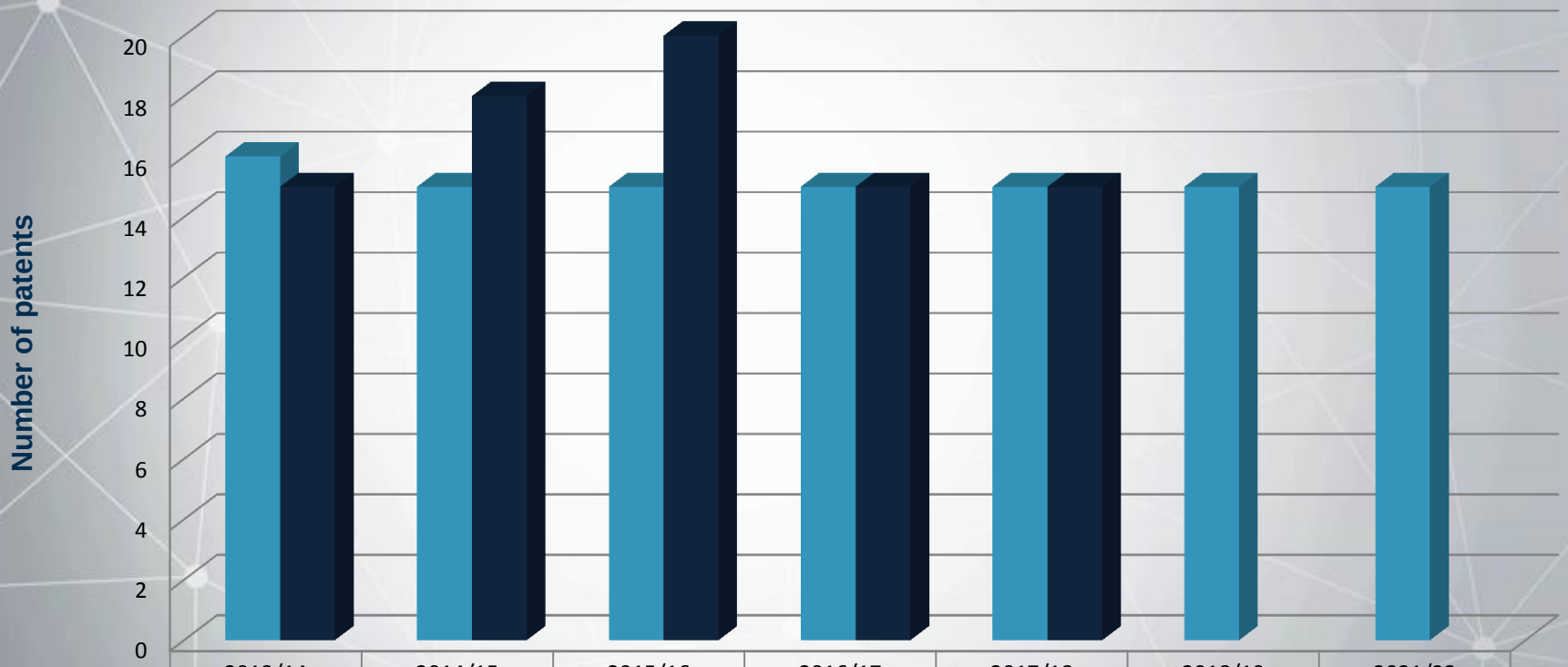
Key performance indicators
Patents awarded

Trend in new patents



	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2021/22
Target	16	15	15	15	15	15	15
Projected	15	18	20	15	15		

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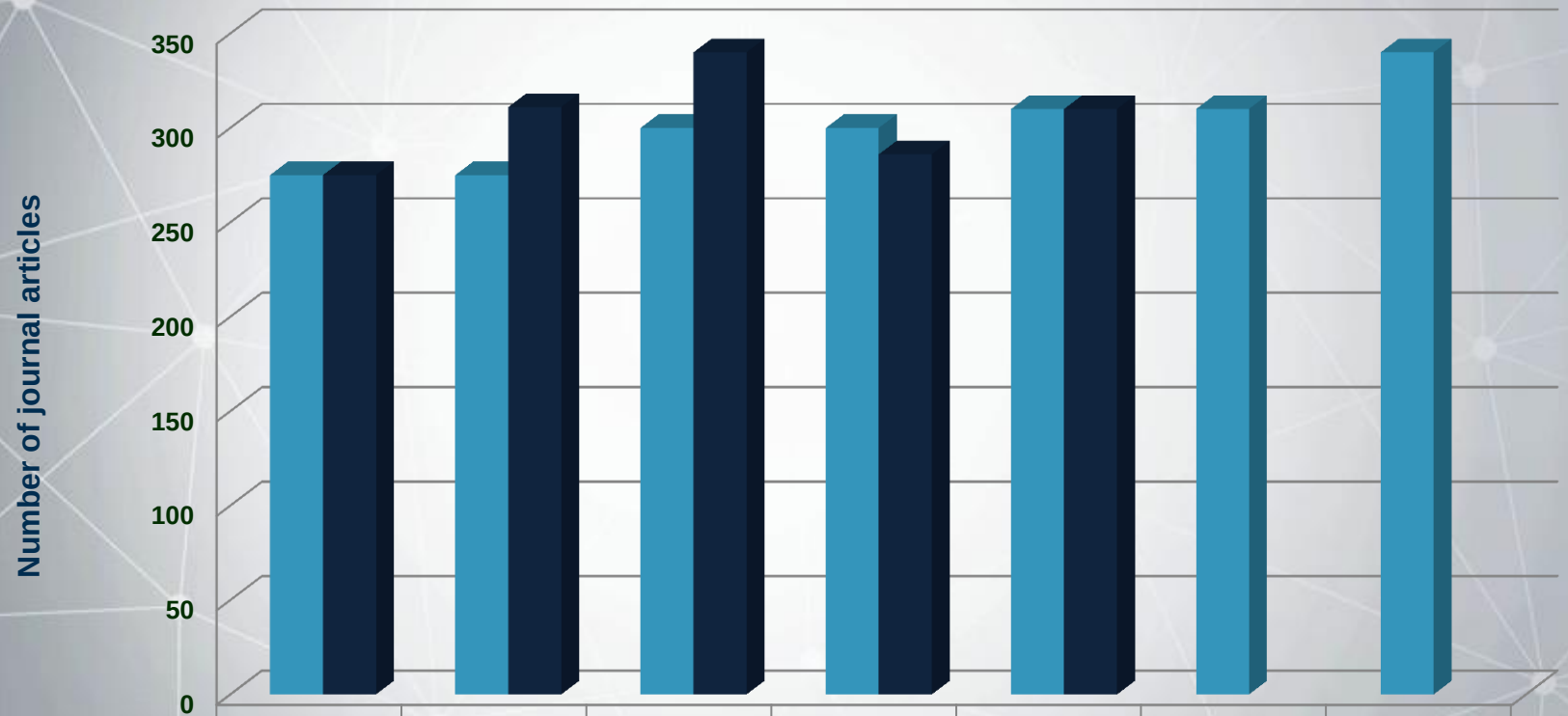
Key performance indicators
Journal articles

Trend in journal articles



	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2021/22
Target	275	275	300	300	310	310	340
Projected	275	311	340	286	310		

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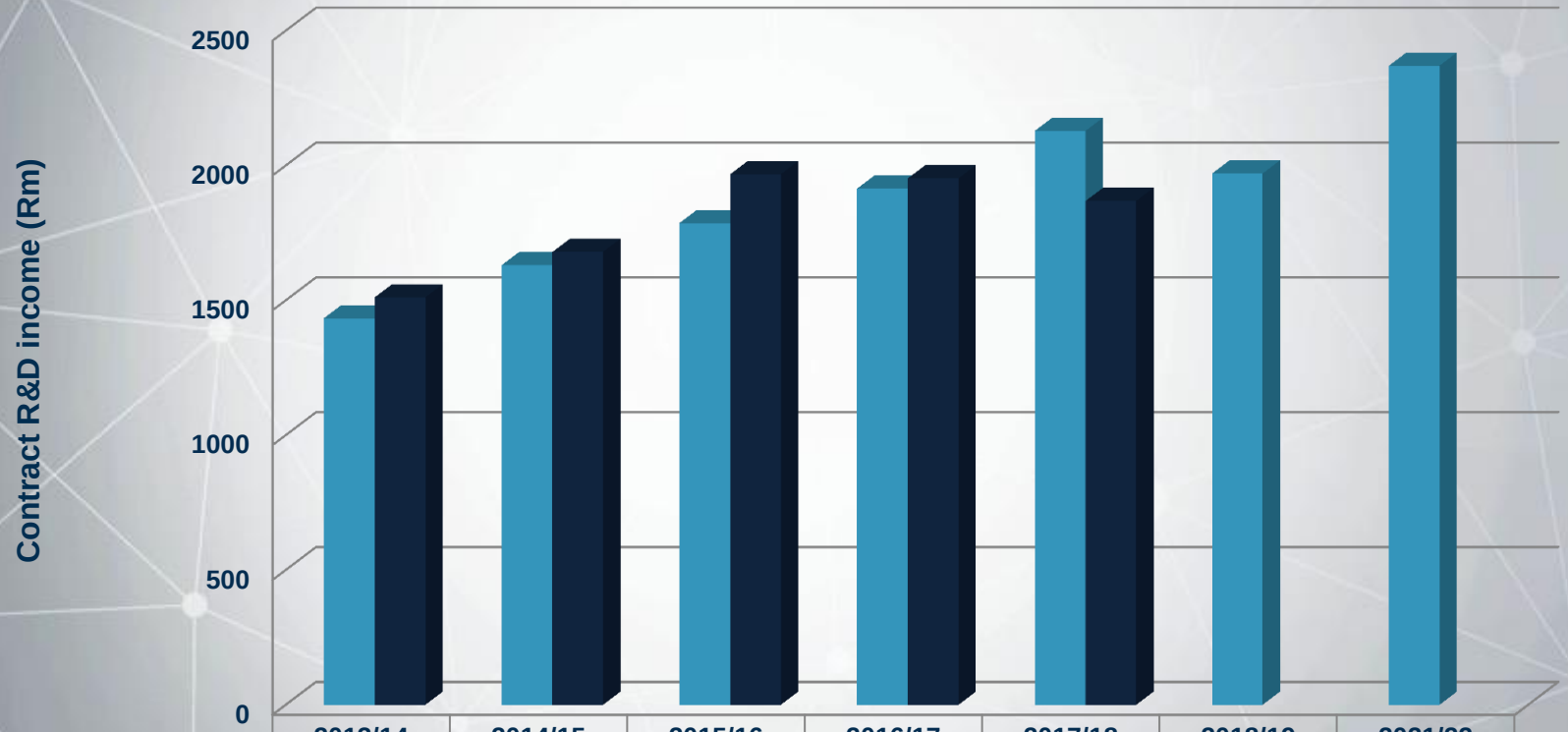
Key performance indicators
Contract R&D income

Trend in contract R&D income



	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2021/22
Target	1433.3	1630	1786	1914	2128	1970	2370
Projected	1510.6	1679	1967	1952	1868		

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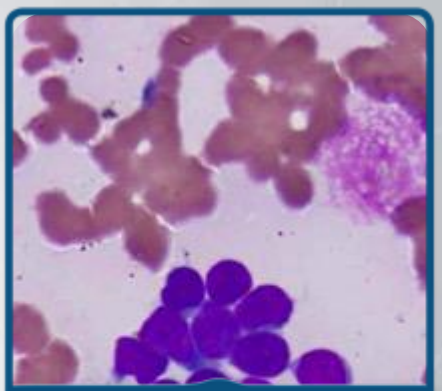
PATENTS: A LEAD INDICATOR OF INNOVATION

Determining the integrity of underground rock walls: Canada

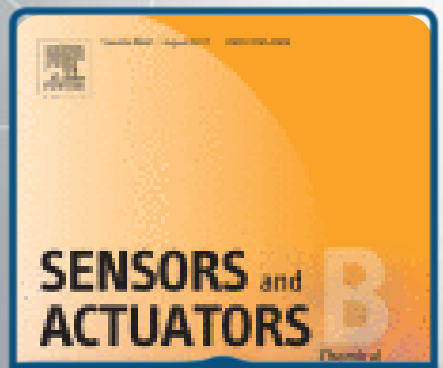
Detecting and monitoring certain diseases using a breath analyser: USA

Producing crystal-line titanium powder: USA



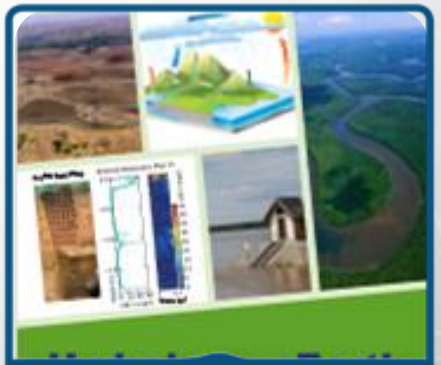
System for the analysis of blood samples: China

JOURNAL ARTICLES: CONTRIBUTING TO THE KNOWLEDGE BASE



Improving methane gas sensing properties of multi-walled carbon nanotubes by vanadium oxide filling

Ultra-sensitive and selective NH3 room temperature gas sensing induced by manganese-doped titanium dioxide nanoparticles



Analysing surface energy balance closure and partitioning over a semi-arid savanna FLUXNET site in Skukuza, South Africa

Modelling of air gap membrane distillation and its application in heavy metals removal

Key priorities: 2018/19
Integrated Water Research Centre

Context

- South Africa is a water-scarce country
- Challenges in water availability and quality
- Influenced by climate change, pollution, industrial effluent, acid mine drainage
- More than 10% of population have no access to potable water
- CSIR research in water is fragmented and the value proposition is unclear

Strategic objectives

Develop:

- Water resource decision-support frameworks
- Solutions for water treatment and contaminant detection
- Guidelines for water and sanitation norms and standards
- Solutions for smart and efficient water infrastructure management

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Key priorities: 2018/19
National Integrated Cyberinfrastructure System

Context

- National infrastructure that drives research, development, innovation and service
- Aligned with national ICT Roadmap
- Cross-cutting platform that supports diverse sectors
- Of increasing importance as organisations become more ICT and data-driven
- Need for appropriate positioning, profiling, strategic leadership

Strategic objectives

- Set up NICIS as a CSIR centre
- Provide seamless access for research and teaching community to ICT infrastructure
- Strategically position key partners in private and public sector

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Key priorities 2018/19
Strengthening existing capabilities: Nanostructured materials

Context

Infrastructure: Facilities from research to pilot

Human capital: More than 130 postdoctoral fellows, PhD and Master's students

Journals and publications: 17 scientific articles featured on journal cover pages and top-rated articles with more than 8 000 citations

Patents and products:

- A prototype breath analyser to detect diabetes without the need for a blood test
- Nano-based cosmetic formulations for cosmetic products
- Nano-particles for advanced fertilisers

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Key priorities 2018/19
Strengthening existing capabilities: Nanostructured materials

Strategic objective
Continued emphasis on human capital development and high-quality SET outputs

Target 2018/19

65	20	4	1	38
number of SET staff	SET staff with PhDs	technology demonstrators	patents	publication equivalents

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STRATEGIC OBJECTIVE 3

Conduct relevant research to foster industrial development

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Key priorities 2018/19: Fostering industrial development

Fourth Industrial Revolution Centre

- Assist South African industry with adoption of new integrated digital and advanced manufacturing technologies
- Host demonstration facilities, learning factories, PLM platform, digital lab, centralised technologies platform

Explore new innovation platforms

- Engineered products capability
- Pharmaceuticals industry support
- Advanced materials

Strengthen existing innovation programmes

- Support and growth of IIP platforms: nanomaterials, biomanufacturing, photonics, biorefinery, nano-micro manufacturing
- Continued support for industry support platforms: Technology Localisation, Enterprise Creation for Development, National Cleaner Production Centre

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Key performance indicators
Research for industrial development

Indicator	Actual 2016/17	Target: 2017/18	Projected 2017/18	Target: 2018/19
New technology demonstrators	56	≥35	40	≥50
Royalty and licence income (Rm)	R5.4 m	R4 m	R4.1 m	R4 m

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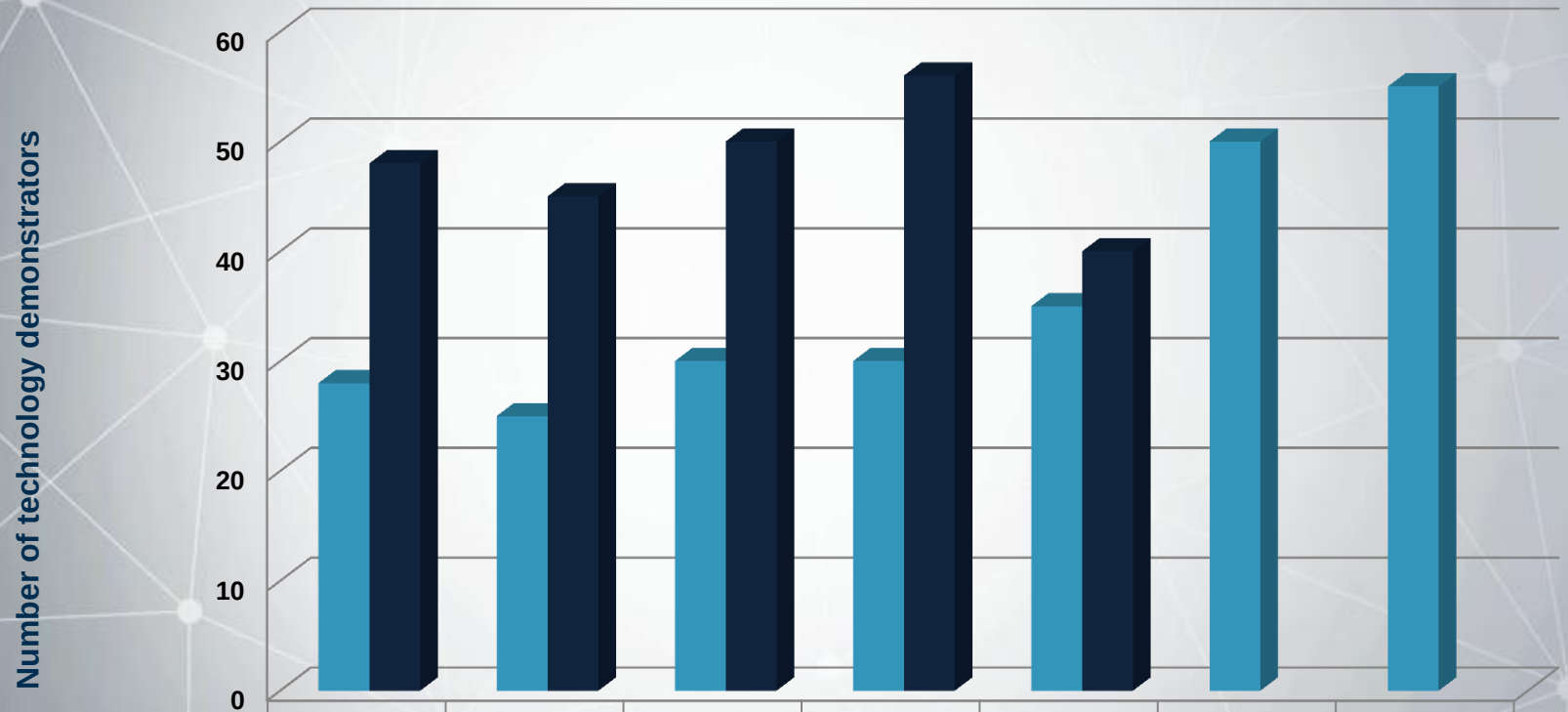
Key performance indicators
New technology demonstrators

Trend in technology demonstrators



	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2021/22
Target	28	25	30	30	35	50	55
Projected	48	45	50	56	40		

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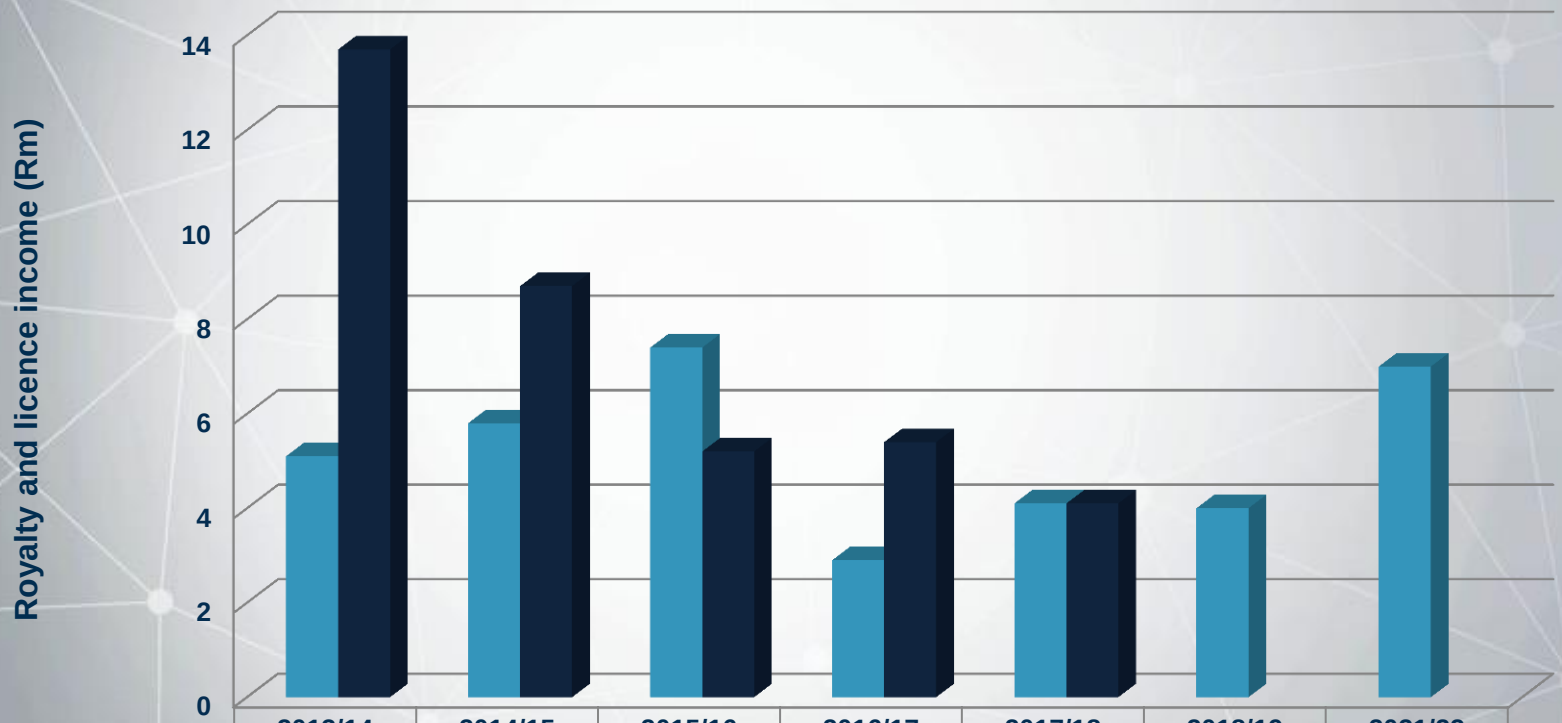
Key performance indicators
Royalty and licence income

Trend in royalty and licence income



	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2021/22
Target	5.1	5.8	7.4	2.9	4.1	4	7
Projected	13.7	8.7	5.2	5.4	4.1		

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TECHNOLOGY DEMONSTRATORS

Making cheaper, greener cement

Systems to reduce rhino poaching

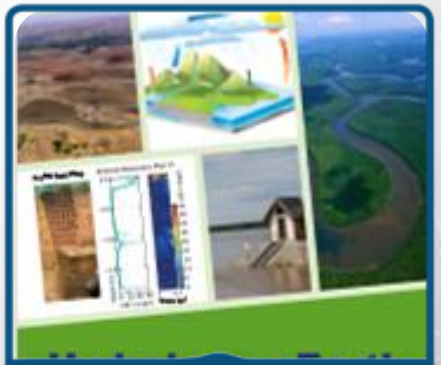
Preventing blockages in mine slurry pipelines

Radar technology to monitor from the sky

ROYALTY AND LICENCE INCOME

Noseclip and mouthpiece for self-contained selfrescuers

Streaming mobile videos without buffering



Visualising ultraviolet discharge – electricity leaks – on power lines

Microspheres used to bind molecules

A new strategy for fostering industrial development

- Support existing industries and boost productivity through incremental innovations
- Revitalise declining industries to enable new products and job creation
- Create new industries and transform existing industries through radical innovation
- Inspire new products, disrupt existing markets and unlock billions in value to industry
- Engage with diverse industry stakeholders to bring new ideas to market
- Scale up R&D to bring ideas, processes and products to commercial release
- Guide emerging technologies from the innovation process to market success

Project Synapse emerging interventions

Strategic programmes (national strategic assets) must be:

Industry 4.0 showcases – digital competitive manufacturing platforms and support services, new technologies, new applications, new products and services platforms

Platforms for support to existing and new industries, and fostering industry/R&D networks

Environments for workforce transformation (skills, diversity), notably artisans; new engagement models for human capital

Centers of technological and business model innovation

Research and development hubs

Support infrastructure for regulatory/standards and policy development

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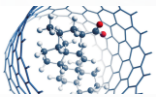
Project Synapse emerging interventions

Strategic programmes:

Engineered assembled products;

- Increase exports, capture share of global high value manufacturing through technological support to high value manufacturing sector supply chains



Advanced materials

- Reinforce high-value manufacturing industries to increase exports through concurrent engineering and Industry 4.0 approaches to materials development

Bio-Chemical conversions platform

- Establish green approaches to the development of high value chemicals and materials from biological and petro-chemical feedstocks

Pharmaceuticals initiative

- Import substitution and security of supply of critical drugs through contribution to local pharmaceuticals manufacturing capabilities, specifically flow chemistry, related scale up and requisite skills

Agro-processing initiative

- Reinforce growth in the sector, redistribute value to producers, through technological support to food and materials processing; create niche enterprises associated with agricultural production

The nexus initiative

- Develop capabilities to expand the resource envelope for industrial growth through strategic decision-support to address natural resource consumption, industrial growth and resource use trade-offs

Industry 4.0 initiative

- Develop a coordinated approach to capacitating the CSIR, its innovation partners and in particular industry, to embed Fourth Industrial Revolution technologies for a competitive South Africa.

Key priorities 2018/19: Fostering industrial development

Fourth Industrial Revolution Centre

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- Host demonstration facilities, learning factories, PLM platform, digital lab, centralised technologies platform

Explore new innovation platforms

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Strengthen existing innovation programmes

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Industry Innovation Programmes

Programmes

- Biomanufacturing Industry Development Centre
- Nanomaterials Industrial Development Facility
- Biorefinery Industry Development Facility
- Photonics Prototyping Facility
- Nano-micro Device Manufacturing Facility

biotech

nanomaterials

biorefining

photonics

OUTPUT AND IMPACT TO DATE

86	27	14	131	225	28
products in the market	products in prototyping/ market testing phase	established industries supported	interns supported	jobs created	SMMEs supported

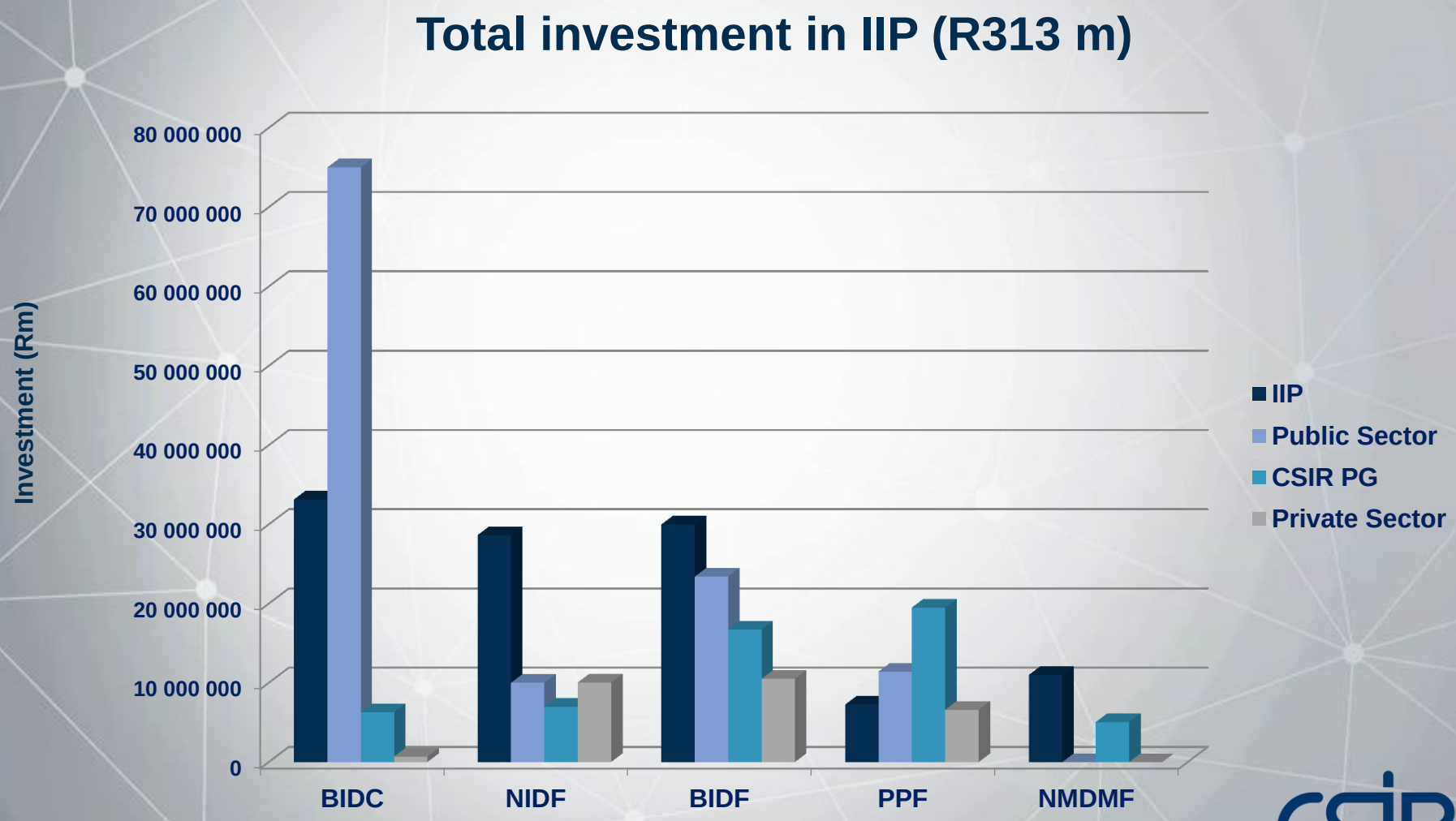
Industry Innovation Programmes

2018/19 Budget: R94 m

Target 2018/19

79	26	34	22	73	60	28
jobs to be created	products in the market	technologies developed	SMMEs supported	interns	beneficiaries	prototypes

Industry Innovation Programmes



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STRATEGIC OBJECTIVE 4

Infrastructure renewal and development

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Context

- The CSIR has not been significantly recapitalised for three decades – ageing and outdated infrastructure
- Interventions required in support of infrastructure renewal
- Requirement for national-level, large-scale translational research infrastructure

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Key performance indicators
Infrastructure renewal and development

Indicator	Actual 2016/17	Target: 2017/18	Projected 2017/18	Target: 2018/19
PPE Investment (Rm)	R144 m	R110 m	R110 m	R61 m

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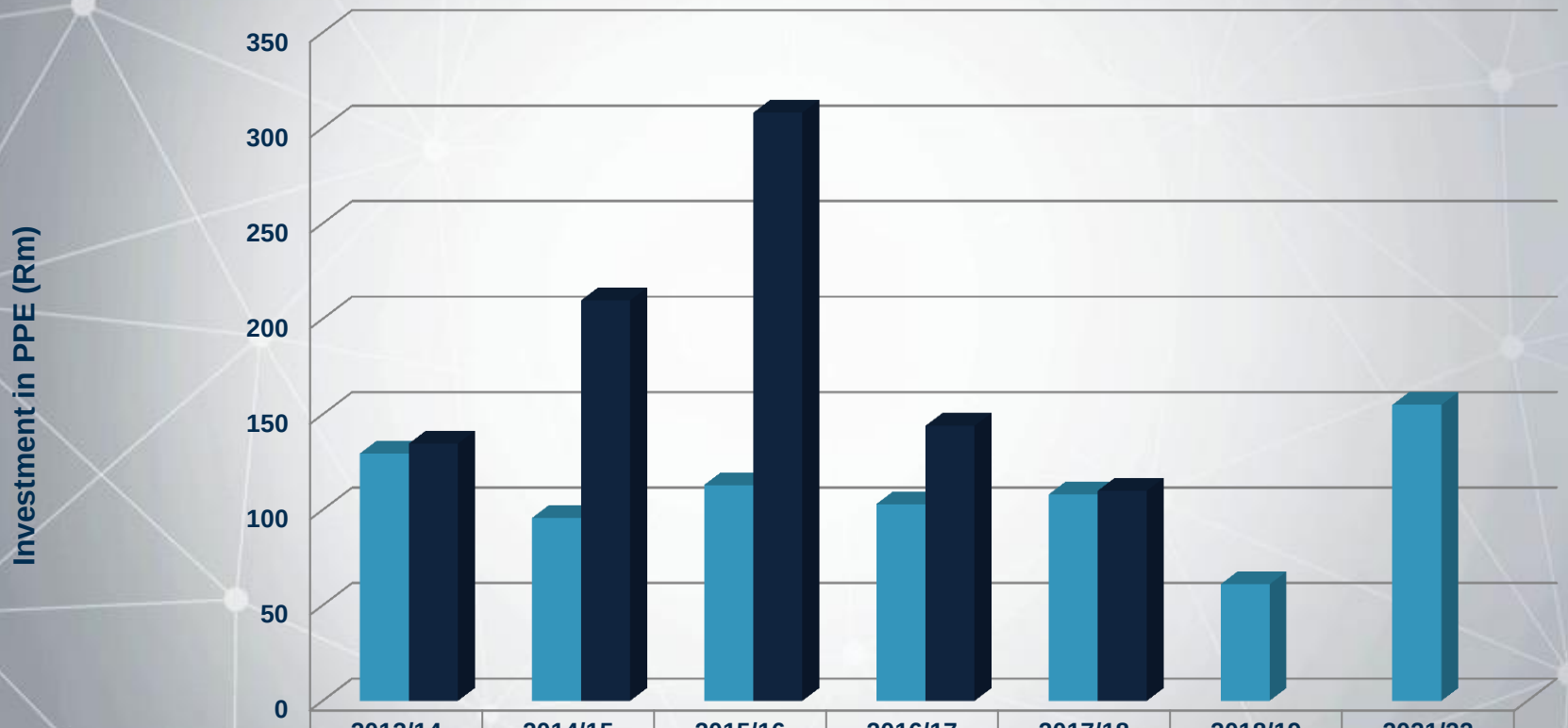
Key performance indicators
Investment in property, plant and equipment

Trend in investment in PPE (Rm)



	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2021/22
Target	129.4	95.7	113	103	108	61	155
Projected	134.7	209.7	308	144	110		

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Key priorities: 2018/19
An energy-autonomous campus

- Long-term aim: An energy-autonomous campus
- Energy from solar, wind, and biogas from biogenic waste
- Three photovoltaic power plants already generating 3 440 MWh of energy
- R3.5 m energy cost savings to date and 3.75 m tonnes of avoided carbon emissions
- Implement energy efficiency solutions to reduce demand by 5%

Planned interventions:

- Installation of a rooftop PV (0.9MW)
- Finalise feasibility studies for wind turbine (3MW) and biogas plant (3MW)
- Demand-side management: Completed campus energy audit
- Develop a business case for a pilot battery project

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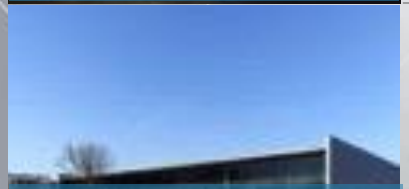
Campus Master Plan
Project implementation timeline: Phase one

Programme/Project	2017	2018 YEAR 1	2019 YEAR 2	2020 Year 3	2021 Year 4	2022 Year 5	2023 Year 6
VISITOR'S CENTRE	CONCEPT	DEFINITION	IMPLEMENTATION				
		GATE 2 PASSED					
SHARED LABORATORY		CONCEPT	DEFINITION	IMPLEMENTATION			
		GATE 1					
RESIDENTIAL AND PARKING	CONCEPT	DEFINITION	IMPLEMENTATION				
		GATE 3 PASSED					
ENERGY AUTONOMOUS PROGRAMME	DEFINITION	IMPLEMENTATION					
			GATE 2 PASSED				
PILOT PLANTS (PHASE 1)	GATE 1	CONCEPT	DEFINITION	IMPLEMENTATION			

Campus Master Plan
Progress to date: Phase one

Project	Progress: Oct – Dec 2017	Service provider	Next stage and future activities: Jan – Mar 2018
VISITORS CENTRE	• Concept • Pre-feasibility	• GAPP Architects and Royal Haskoning Consortium - Technical feasibility analysis • Turner and Townsend – Cost estimating and financial feasibility	• Business case approval
RESIDENTIAL & PARKING	• Concept • Pre-feasibility	• Demacon - Market studies • GAPP Architects and Royal Haskoning Consortium - Technical feasibility analysis • Turner and Townsend – Cost estimating and financial feasibility	• Business case approval
SHARED LABS	• Concept	• GAPP Architects and Royal Haskoning Consortium- Technical feasibility analysis • Turner and Townsend – Cost estimating and financial feasibility	• Approve need analysis/ opportunity study • Define projects
 PILOT PLANTS	• Concept	• GAPP Architects and Royal Haskoning Consortium - Technical feasibility analysis • Turner and Townsend – Cost estimating and financial feasibility	• Approve need analysis/ opportunity study • Define projects

Campus Master Plan
Stakeholder engagement

National Treasury

- Budget office and the Government Transaction Advisory Centre with National Treasury
- Broad support for the CMP vision
- Advisory services and assistance with securing funding

Department of Science and Technology

- Broad support for the CMP vision
- Visitors/Science centre needs gathering - alignment with Science Engagement Strategy

University of Pretoria, NRF Innovation Hub

- Broad support for the Campus Master Plan vision

Parliamentary Portfolio Committee

- Broad support for the Campus Master Plan vision

South African Association of Science and Technology Centres

- Benchmarking study and needs assessment for visitors centre
- Insight into management and funding of science centres in South Africa and challenges

STRATEGIC OBJECTIVE 5

Financial sustainability and good governance

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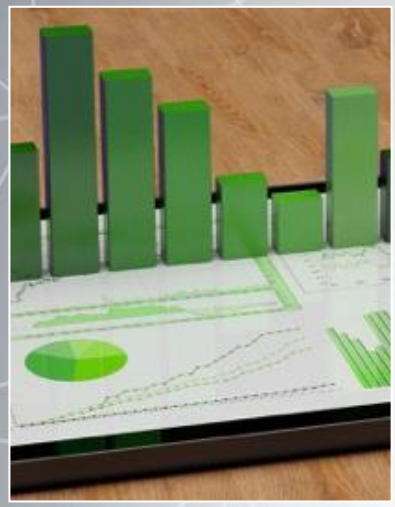
Context



- Adverse economic climate and tight fiscal environment
- Decline in national R&D investment
- Tapering trajectory in overall growth
- Challenges in procurement from other state-owned entities and government departments

Achieve 5.5% growth in contract income

- 5% growth in parliamentary grant
- 8% growth in public sector income
- 16% growth in private sector income
- R61 investment in PPE

Maintain good governance

- Maintain unqualified audit status
- Apply strict cost containment measures
- Make investments aligned with strategy
- Monitor and manage the Ethics Hotline
- Achieve Level 2 B-BBEE status
- Risk management

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Key performance indicators
Financial sustainability and good governance

Indicator	Actual 2016/17	Target 2017/18	Projected 2017/18	Target 2018/19
Total Income	R2 712 m	R2 863 m	R2 603 m	R2 740 m
Net Profit	R95.5 m	R64 m	R-32 m	R0 m
B-BBEE Rating	Level 3	Level 2	Level 2	Level 2
Contract R&D income	R1 952 m	R2 009 m	R1 868 m	R1 970 m
Disabling Injury Frequency Rate	0	0.2	0.07	0.2

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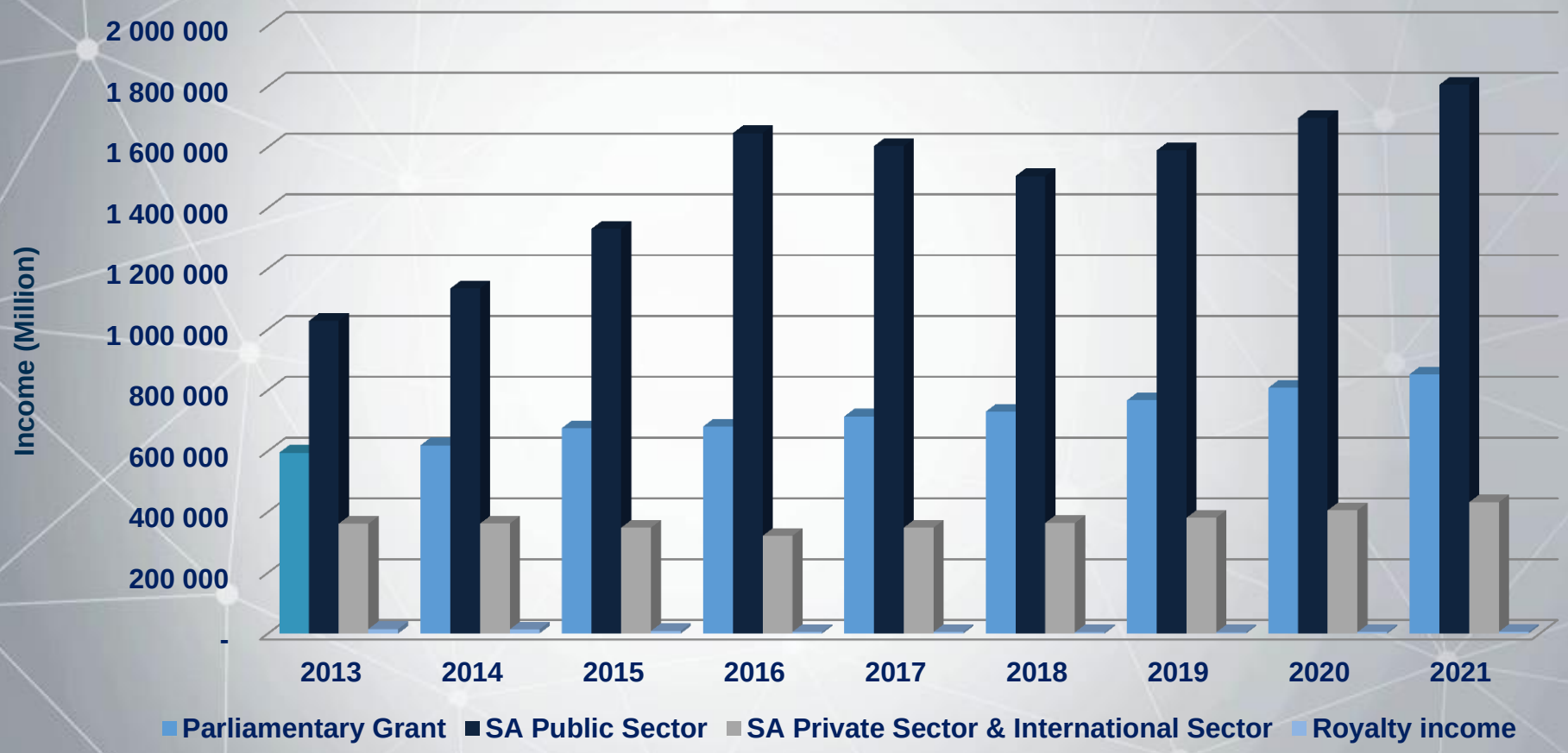
Key performance indicators
Trend in total income



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CSIR Partnerships

Key partnerships support the CSIR to achieve the following objectives:

- Develop human capital
- Leverage external skills and resources to drive scientific and industrial development
- Creative competitive market offerings
- Enable enterprise development
- Create innovation ecosystems

Higher education institutions

State-owned entities

Government Depts. & entities

Private sector

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CSIR Stakeholder engagement

In line with the DST Stakeholder Engagement Framework:

2018/19 Engagement initiatives

- **Improving public understanding of science**
  - Support national science week
  - Science festivals (Scifest, Sasol Techno-X)
  - Implement advertising campaign “Ideas that work”
  - Community media partnership to profile black scientists in vernacular languages

- **Encouraging youth to take up careers in science**
  - CSIR career days
  - CSIR Emerging Researchers Symposium
  - Community outreach programme to promote STEM careers
  - Use of CSIR laboratories at universities to educate students in local communities on specific topics

- **Industry engagement**
  - Launch of Photonics Prototyping Facility
  - Participation at Africa Aerospace and Defence show
  - Technology demonstrator day to facilitate technology licensing

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Thank you

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