The CSIR Annual Report 2012/13

Presentation to
the Parliamentary Portfolio Committee on Science and Technology

9 October 2013

our future through science

Content outline

1. **CSIR mandate and role**

2. **Key performance indicators**
   - Building and transforming human capital
   - Strengthening the science, engineering and technology base and performing relevant R&D
   - Transferring technology and skilled human capital
   - Financial sustainability, good corporate governance and citizenship

3. **Project highlights**

CSIR
our future through science

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)

CSIR
our future through science

Unpacking the CSIR mandate

Inputs | Activities | Outputs | Outcomes | Impact

CSIR Mandate

- Multidisciplinary research
- Technological innovation

- Industrial development
- Scientific development

Improved quality of life

Collaboration, partnering

CSIR Response

Research impact areas and core technologies

- Create new industries
- Improve competitiveness of existing industries
- Support service delivery
- Access to social and economic infrastructure
- Support to job creation
- Sustaining the natural environment

In support of national priorities

Collaboration, partnering

To slide 9

SA's priorities as defined by its National Development Plan

CSIR response

Low High

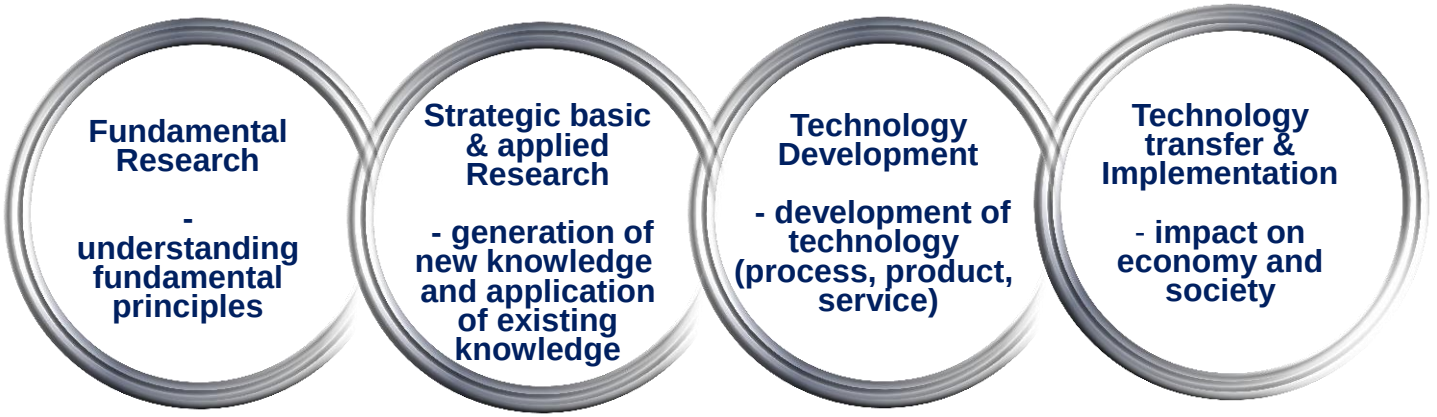
our future through science

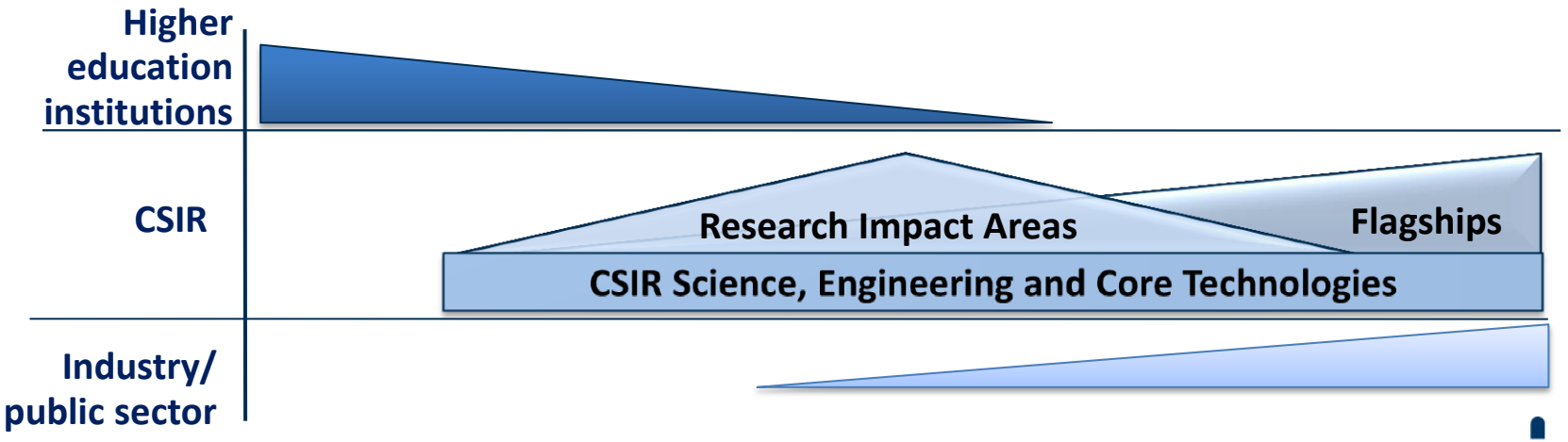
Focus for national impact: Research impact areas

Core technologies & facilities

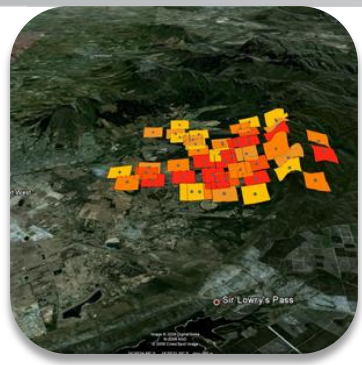
- Materials
- Sensors
- Photonics
- Robotics
- ICT
- Modelling
- Research facilities

The CSIR role in the innovation chain





Examples of economic and social impact



A satellite-based fire information tool that reports active fires in near-real time. Fires cause faults which shorten the life of the equipment. An Eskom trans-former ranges in cost from **R20m to R75m**

Technology to produce titanium powder directly in a continuous manner. SA earns **~$0.29/kg** when it exports ilmenite, but pays **$30/kg** when it imports it back as titanium metal

An ultrasonic system that detects railway breaks to prevent derail-ments: A single freight train derailment is estimated at **R50m** per incident

A leak-sealing method to repair water cooler tanks at Koeberg while in use. Cost of replacement of one tank **~R1 billion**. Repair extends the lifetime of present tanks by up to 10 years

Rubber noseclip and mouthpiece patented. Some **500 000** self-contained self-rescuers used to supply oxygen to miners during emergencies use these, following licensing agreement with Afrox

A wireless mesh network for rural access to broadband

Back

CSIR
our future through science

A schedule 3b entity – National Government Business Enterprise

Schedule 1	Schedule 3a	Schedule 3b	Schedule 2
Constitutional Institutions	National Public Entities	National Government Business Enterprises	Major Public Entities
Human Rights Commission	NRF	CSIR	Eskom
Independent Electoral Commission	TIA	Mintek	Denel
	HSRC	SABS	Transnet
	SANRAL / FSB	Rand Water	IDC / DBSA

A 3b entity can budget for a surplus or deficit (S53 (3) of the PFMA). Certain Treasury Regulations are not applicable to a 3b entity. VAT Act and Income Tax Act have specific provisions pertaining to 3b entities

TIA: Technology Innovation Agency
NRF, TIA, HSRC and CSIR report to the Minister of Science and Technology

CSIR
our future through science

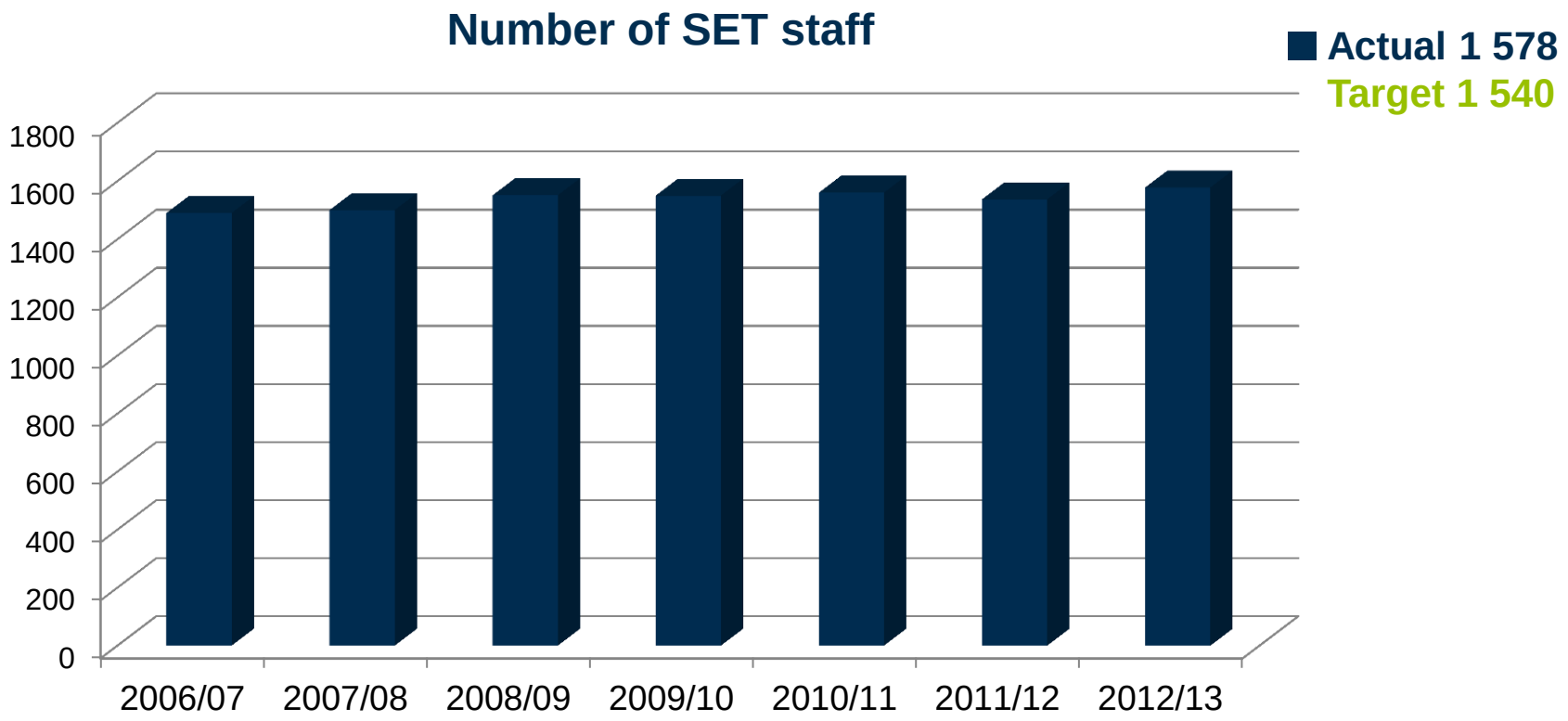
Key performance indicators

CSIR
our future through science

Key performance indicators at a glance

Strategic focus area	Key performance indicator	2012/13 Target	2012/13 Actual
Human resource management	Total size of SET base (number, %)	1 540 (64.5%)	1 587 (65.4%)
	% of SET base who are black	48.0	48.6
	% of SET base who are female	32.0	32.1
	Number of staff with doctoral level qualifications	310	301
R&D outputs	Publication equivalents	575	503
	New technology demonstrators	26	33
	Value of investment in property, plant and equipment	R93.5 m	R130.1 m
R&D outcomes	New patents granted	15	35
	Royalty and licence income	R10.5 m	R14.8 m
Contract R&D	Contract R&D income	R1 275.8 m	R1 403.1 m
	Private sector and international income	R364.1 m	R364.7 m
Financial sustainability	Total income	R1.88 billion	R2.02 billion
	Net profit	R38.6 m	R48.4 m
Corporate governance and citizenship	BBBEE rating	Level 3 contributor	Level 2 contributor
	Energy efficiency (reduce consumption)	1.2% reduction	0.98% increase
	Disabling injury frequency rate	<0.3	0.04

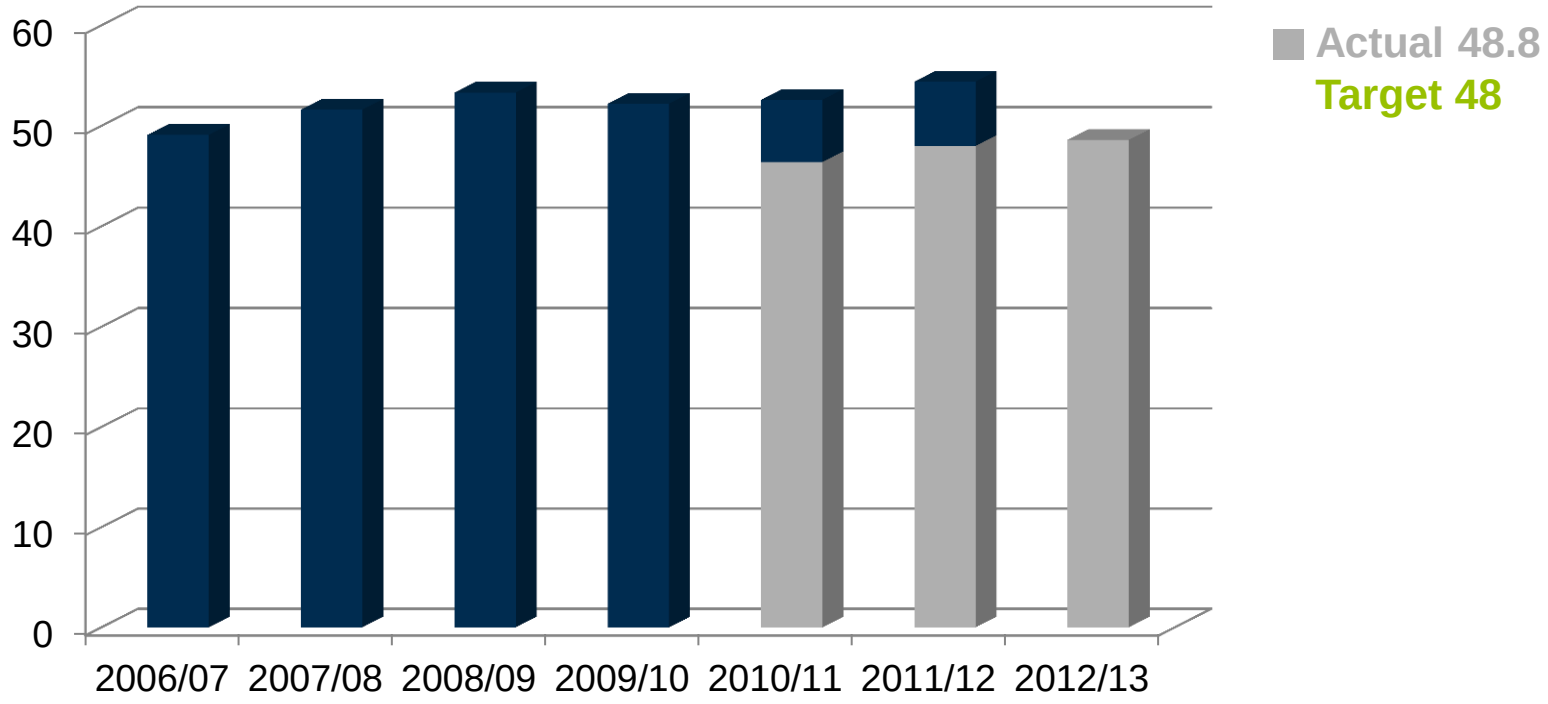
Building and transforming human capital
Science, engineering and technology (SET) staff



45 SET staff to SANSA in 2011/12

Building and transforming human capital
Black SET staff

% black SET staff



Only SET staff who are black SA citizens included from 2012/13

CSIR
our future through science

Building and transforming human capital
Staff with doctorates: Some new doctorates awarded

Dr Mary-Jane Bopape

Meteorologist
Predicts climate change

Dr Angela Dudley

Laser physicist
Designs new lasers

Dr Siyavuya Bulani

Biotechnologist
Develops new industrial enzymes

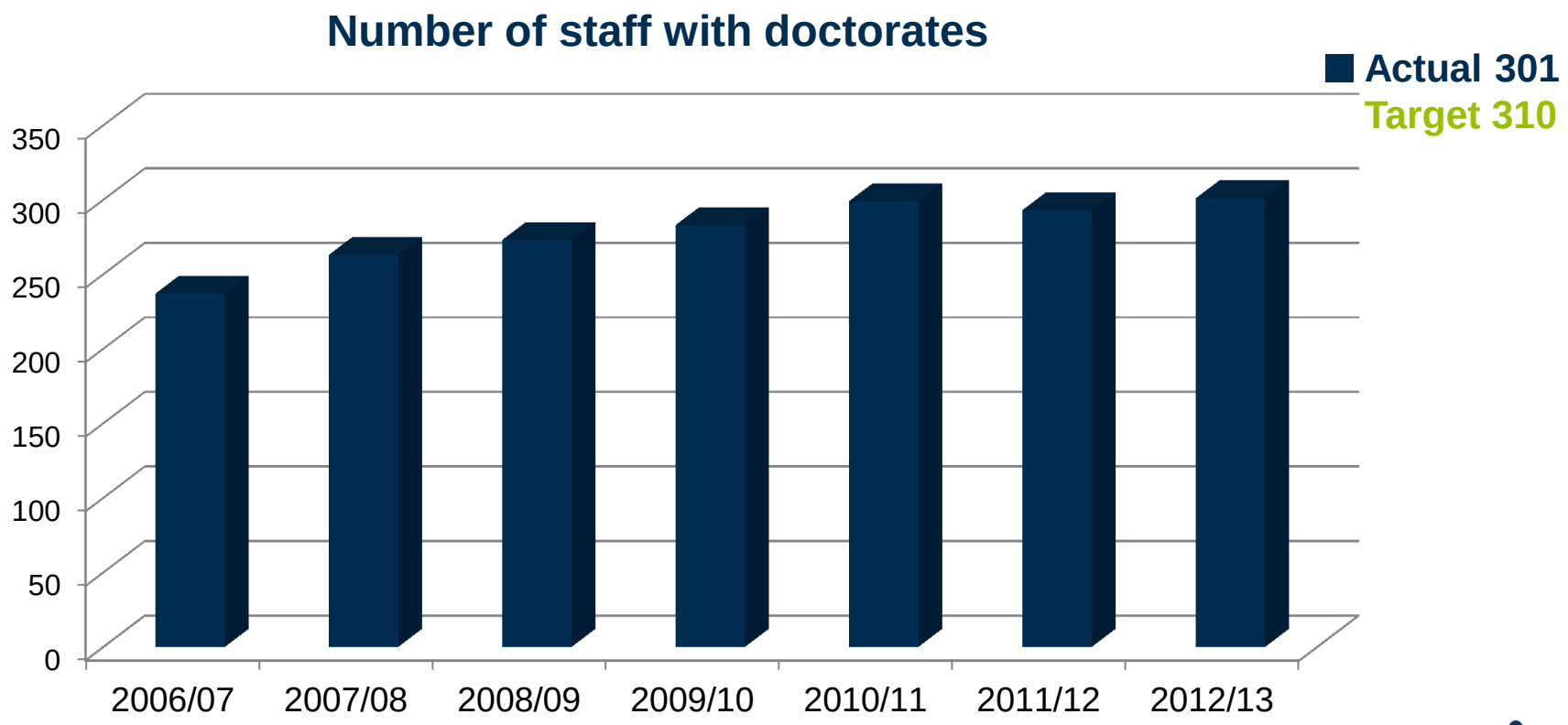
Dr Hazel Mufhandu

Virologist
Researches virus-related diseases

Dr Doyce Moyo

Textile scientist
Researches non-woven textiles

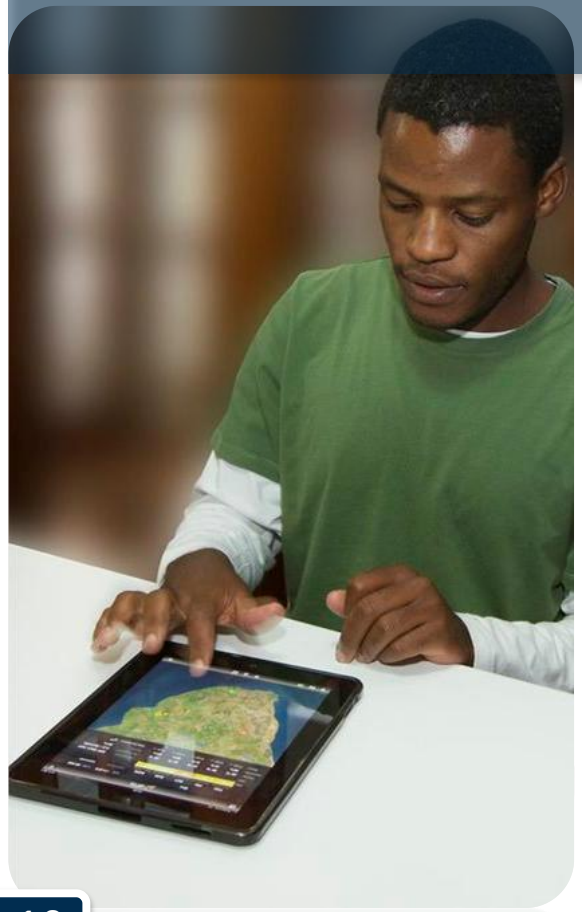
Building and transforming human capital
Staff with doctorates



CSIR
our future through science

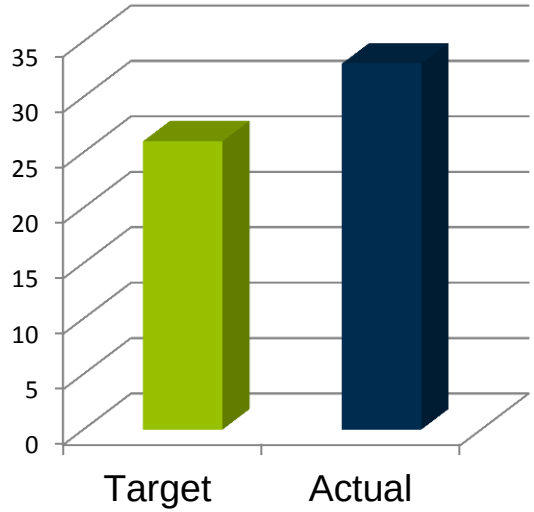
Strengthening the SET base and performing relevant R&D
Technology demonstrators

Fire managers need fire information while on the go. An advanced fire information system application for tablets developed.



Self-powered, handheld device to determine water quality. Transmits data and GPS coordinate over mobile phone networks.

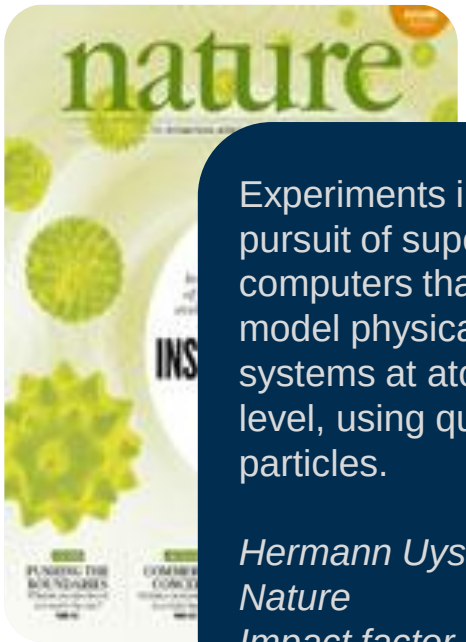
Technology demonstrators 2012/13



CSIR
our future through science

Strengthening the SET base and performing relevant R&D
Publications: Research published by world's top journals

- CSIR authors published 309 articles in accredited journals
- Some 135 had an impact factor of 2 or higher
- Examples of high-impact factor publications:

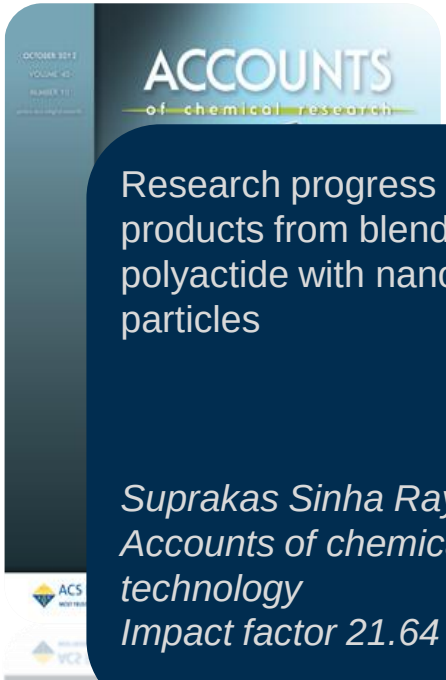


Experiments in pursuit of super-computers that can model physical systems at atomic level, using quantum particles.

Hermann Uys
Nature
Impact factor 36.28

Climate change as a growing threat to food security

Bob Scholes
Science
Impact factor 31.377



Research progress on products from blending polyactide with nano-particles

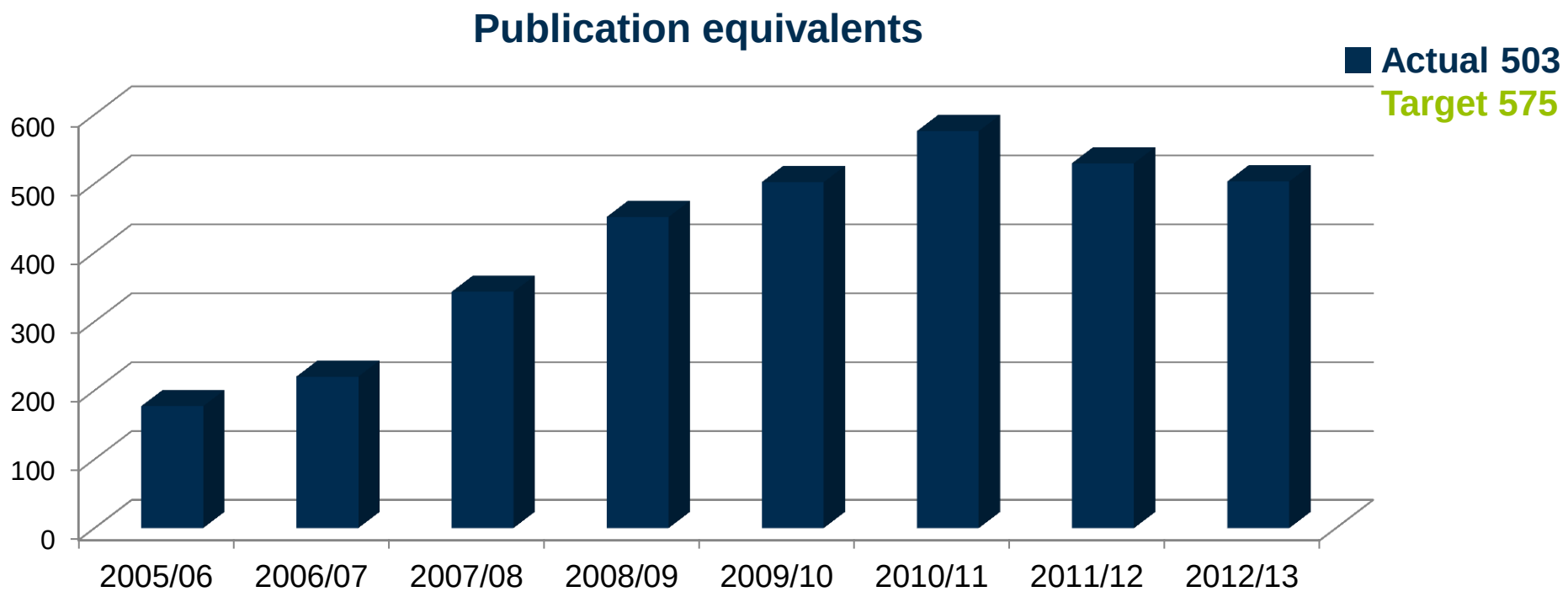
Suprakas Sinha Ray
Accounts of chemical technology
Impact factor 21.64

CSIR
our future through science

Strengthening the SET base and performing relevant R&D
Publications: Inventing the digital laser

- The digital laser is a milestone in laser technology – likely to spur future laser-related developments
- Allows scientists to digitally control laser beams
- Published in *Nature Communications*
- Press conference resulting in coverage worth R2.3m (to date)
  View BBC clip

Strengthening the SET base and performing relevant R&D
Publication equivalents



Transferring technology and skilled human capital
Examples of international patents granted

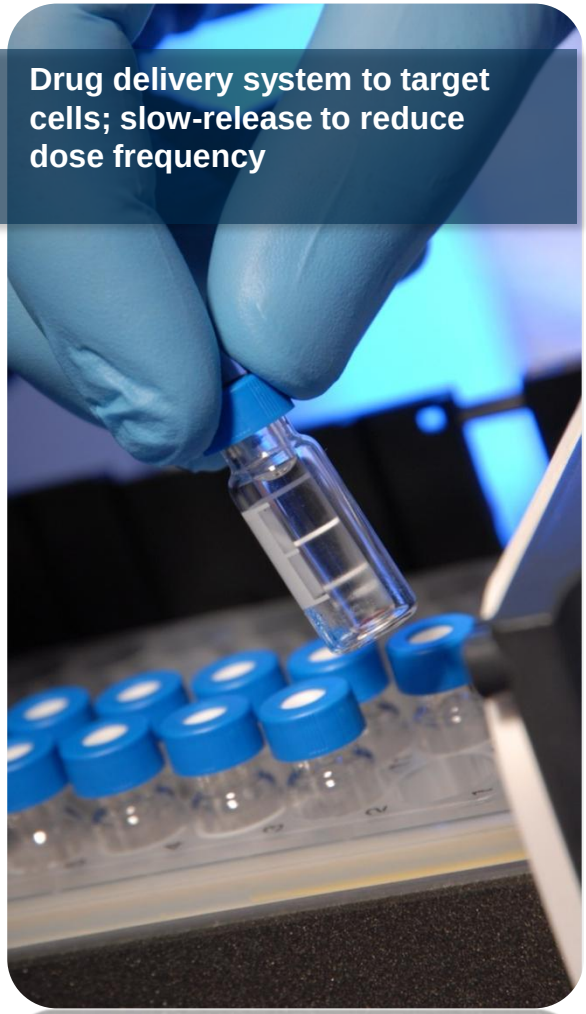
Microspheres resembling balls of wool onto which many molecules, like proteins, can attach

Canada, China, India

Technology to watch live content on mobile phones without interruption to video stream

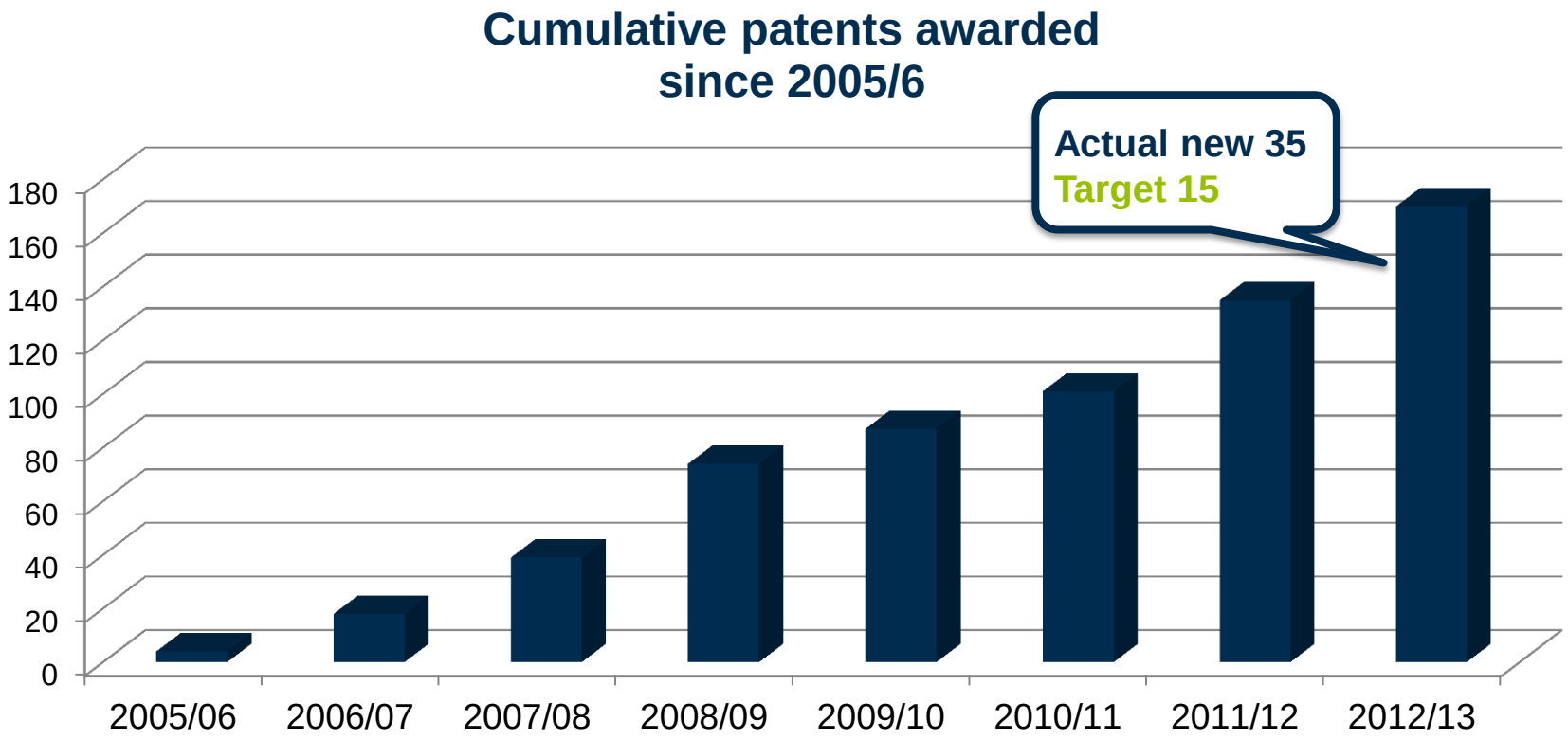
United Kingdom

Drug delivery system to target cells; slow-release to reduce dose frequency



Singapore, United Kingdom

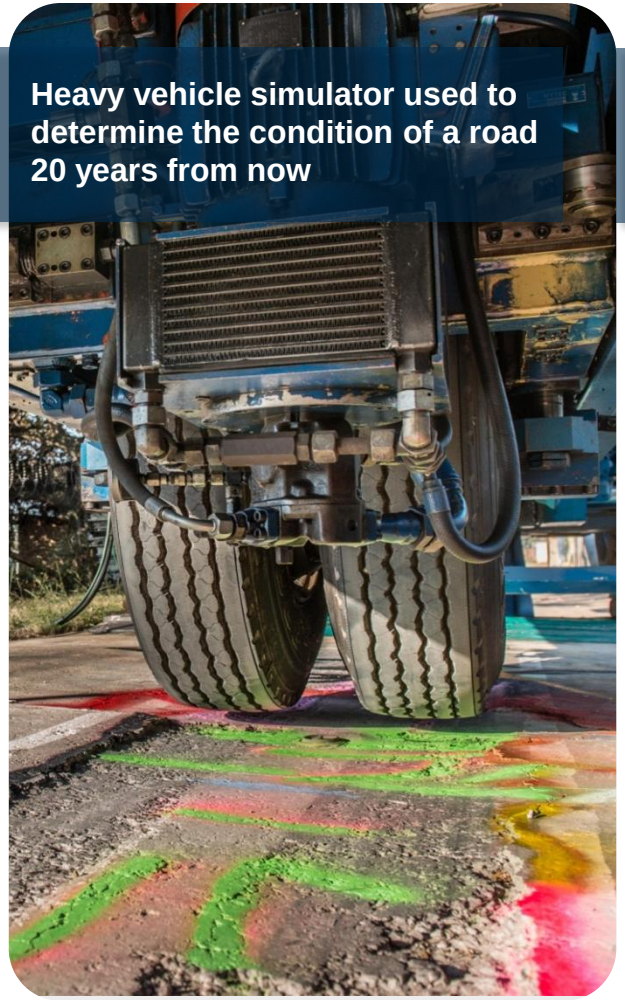
Transferring technology and skilled human capital
Cumulative patents awarded since 2005/6



Transferring technology and skilled human capital
Royalty and licence examples

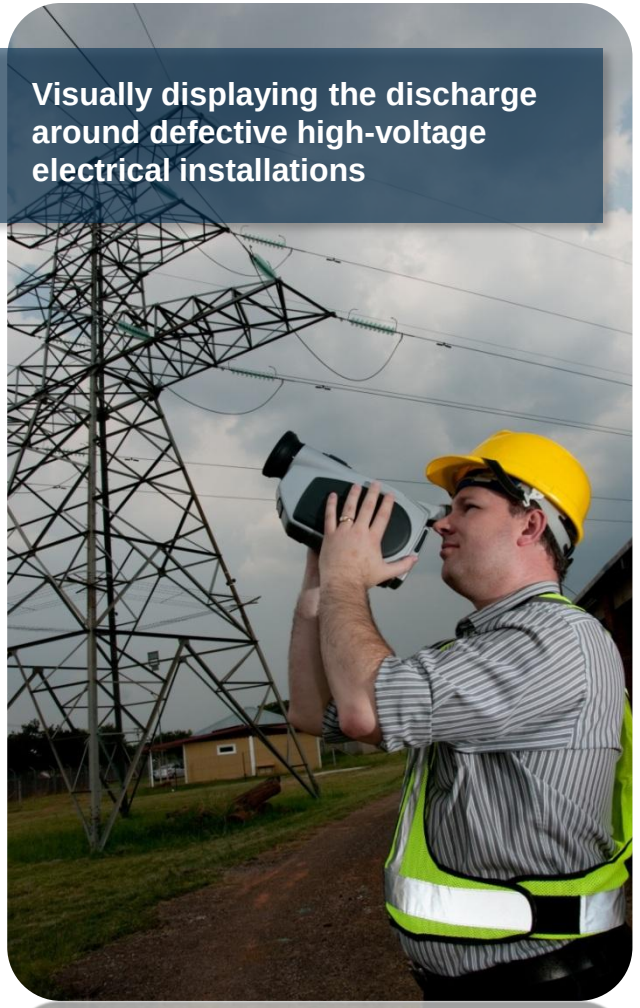
Rubber mouthpieces and noseclips used in self-contained self-rescuers

Afrox; Hannover Engineering



Heavy vehicle simulator used to determine the condition of a road 20 years from now

Dynatest

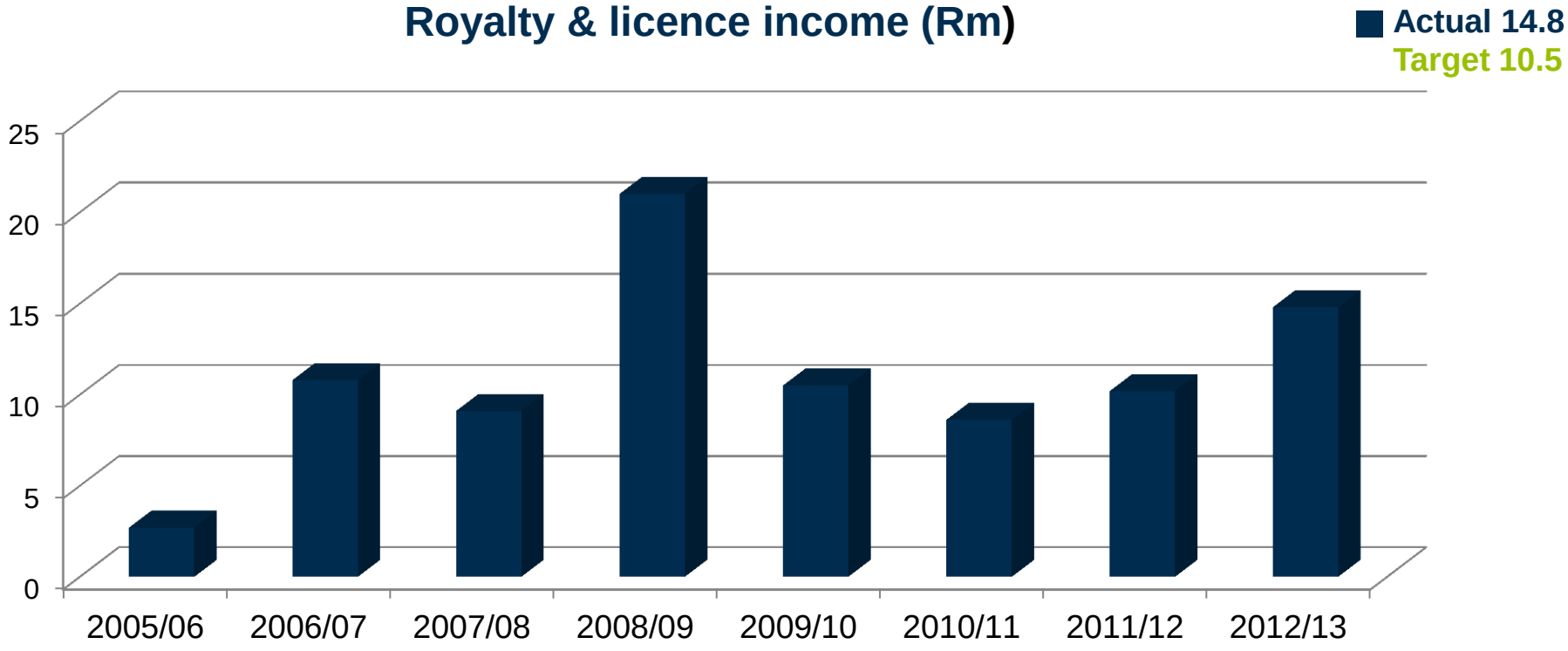


Visually displaying the discharge around defective high-voltage electrical installations

Uvirco

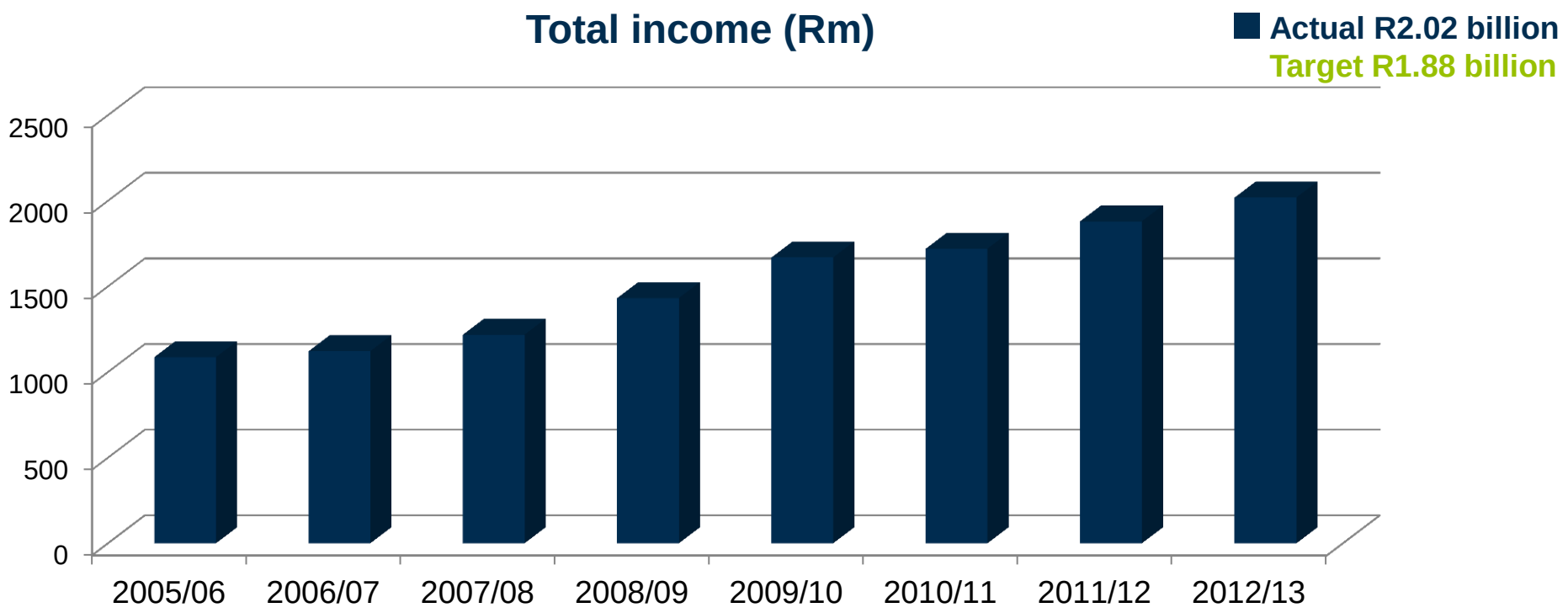
Transferring technology and skilled human capital
Royalty & licence income

Royalty & licence income (Rm)



CSIR
our future through science

Financial sustainability and good corporate governance
Total income

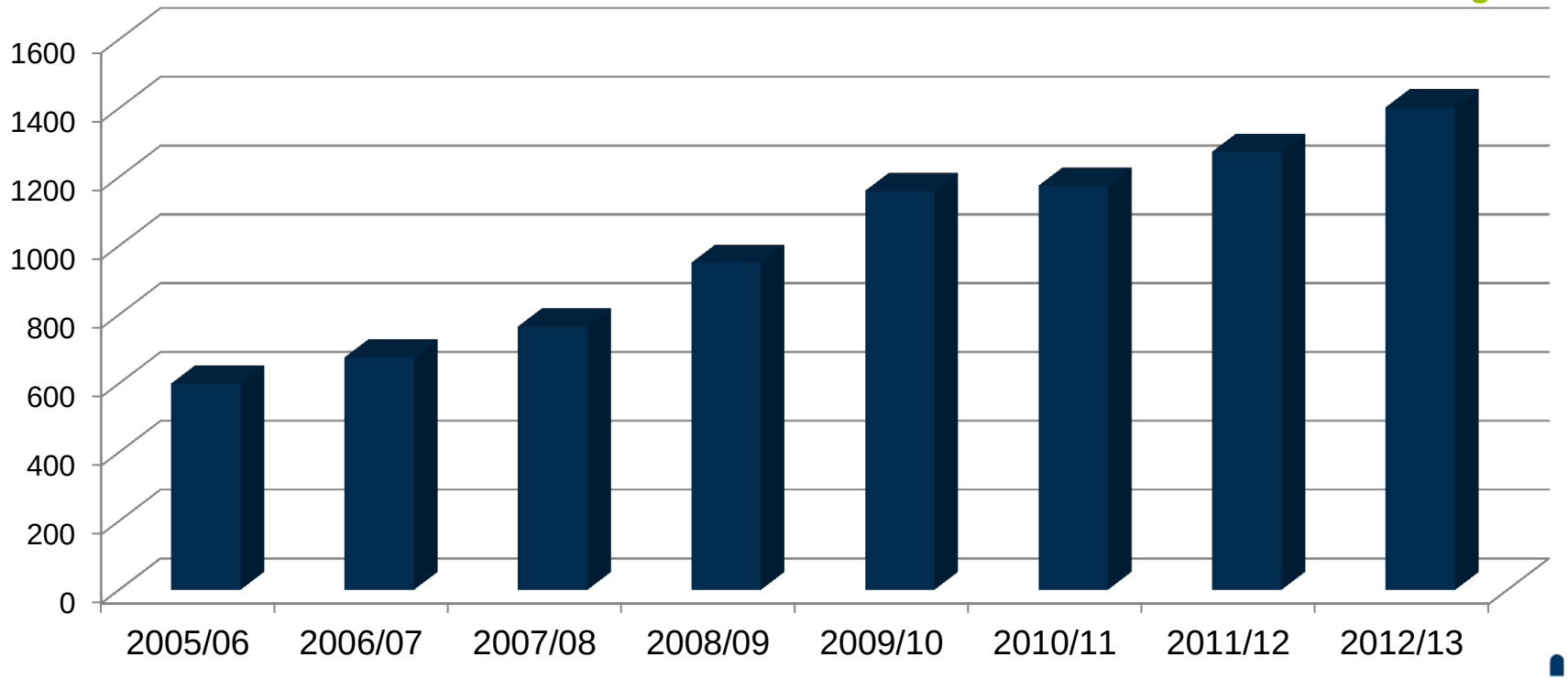


CSIR
our future through science

Financial sustainability and good corporate governance
Contract R&D income

Contract R&D income (Rm)

Actual R1 403.1m
Target R1 275.8m



CSIR
our future through science

Good governance and corporate citizenship

- An unqualified audit report
- Safety target exceeded
  (0.04 disabling injury frequency rate)
- BBBEE target exceeded: Level 2 BBBEE rating
- Energy efficiency target:
  Target 1.2% reduction – actual 0.98% increase
  Energy saving initiatives, but business grew

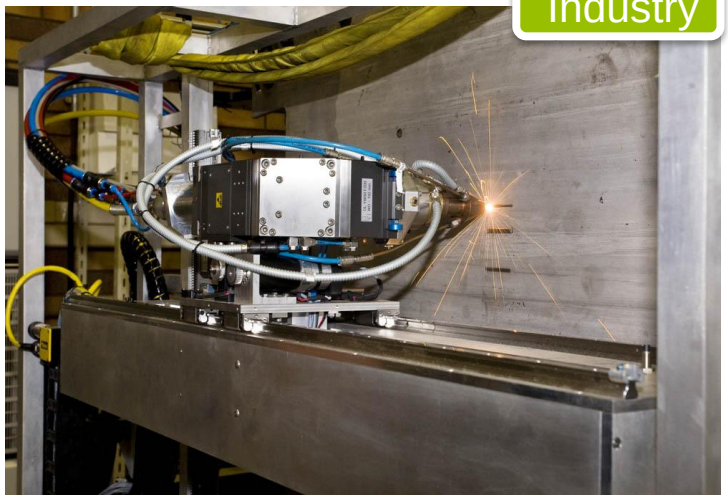
CSIR
our future through science

Project highlights

our future through science

Laser leak-sealing technology proves its mettle

Industry



The challenge

- Sealing leaking water tanks at nuclear power stations where draining for repairs implies down-time

The research and development

- Use laser beam for welding
- Welding solution without having to drain tanks
- Weld overlays with no distortion to original components
- Process approved by National Nuclear Regulator
- A customised (mobile) unit to address Eskom engineering challenges completed

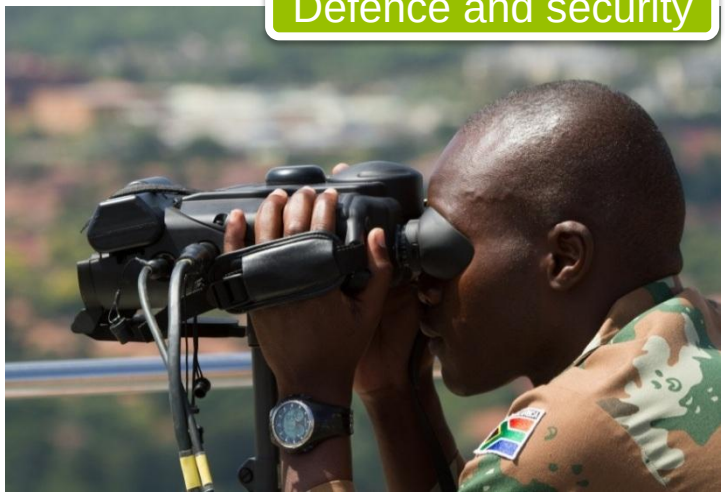
Outcome

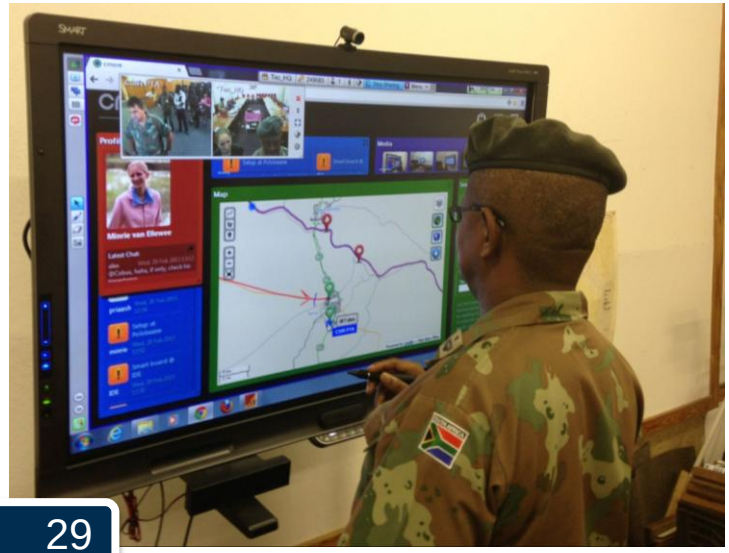
- Two Eskom repair campaigns, extending the lifetime of tanks by 5 - 10 yrs (tank replacement R1 billion)
- Refurbishment technology for other markets
- Patented in SA, USA, Japan, Australia and 5 European countries
- Versatile industrial mobile version deployed to address industry needs

CSIR
our future through science

New approaches to integrative border safeguarding

Defence and security





The challenge

- Enormity of SA border safeguarding: 2 800 km coastline; 4 800 km land border; 10 international airports; 111 sea ports;1.2 million km² air space
- Threats: piracy, poaching, smuggling, illegal entry, terror

The research and development

- Better integration of existing platforms in command, control, communication and surveillance
- Used unmanned aerial systems to capture video views; cell phone intercepts; jamming of GPS; video conferencing
- Successful field experiments:
  - Ladybrand July 2012 – focus on communication infrastructure integration
  - Musina Feb 2013 – system to better observe activities and incidents in the field in real-time

Outcome

- Integration achieved in real-world

CSIR
our future through science

New anti-HIV drug targets found using new microscopy techniques

Health

The challenge

- Understanding the causes of diseases (at a cell level) and finding targets for potential therapies

The research and development

- SA's first super resolution microscope built at the CSIR and installed first high-throughput automated confocal microscope, which can analyse 384 samples in 15 minutes
- Several new techniques pioneered using this infrastructure
- Researchers supress or enhance small molecules that regulate gene expression in host cells and then observe the effect on viral replication using the automated microscope

Outcome

- Number of potential anti-HIV drug targets being patented

CSIR
our future through science

Tackling SA's wastewater issues from all angles

Natural environment

The challenge

- Inadequate wastewater infrastructure planning, failing wastewater treatment works and poor monitoring threaten the environment and communities

Research, development and implementation

- Integrated approach, relying on multidisciplinary skills
- Urban dynamics platform: models future human settlement patterns, forecasts infrastructure demand
- Empowering local communities and local municipalities to mitigate societal health risks
- Working with the Department Water Affairs to establish more effective regulatory environment
- Real-time monitoring units in place to measure water quality and a response team to support municipalities

Outcome

- Initial roll-out to deploy eight monitoring units in KwaZulu-Natal, uMhlathuze Municipality

CSIR
our future through science

Probing the link: Global climate and the Southern Ocean carbon cycle

Natural environment

The challenge

- CO_2 build-up in atmosphere drives global warming
- Half of man-made CO_2 is taken up by the oceans, but climate change might compromise this
- Better ocean data needed to improve the reliability of climate models
- Oceanographic measurements taken from ships and satellites are limited in time and space

The research and development

- State-of-the-art ocean robots deployed to collect data and send back in real-time via satellite
- First ever deployment of CO_2 sensor robots in Southern Ocean in Sep 2012
- Role of light, iron on phytoplankton studied in modern, ultra-clean container labs in SA Agulhas II

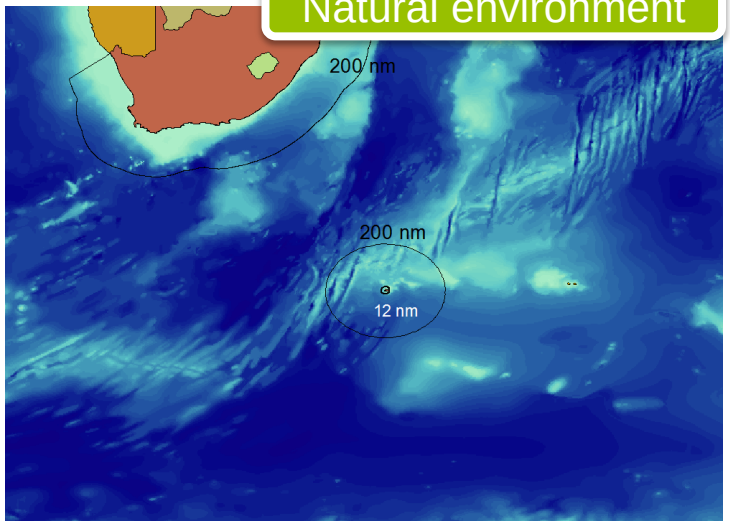
Outcome

- Analysis of data has started
- New ocean robotics capabilities in SA

CSIR
our future through science

Conservation plan leads to Prince Edward Island marine protected area

Natural environment



The challenge

- Marine areas around SA territory, Marion and Prince Edward Islands not protected
- Rampant poaching threatened wildlife

The research and development

- CSIR and partners collated decades of data on the species of these islands and analysed the requirements for a comprehensive conservation zoning plan

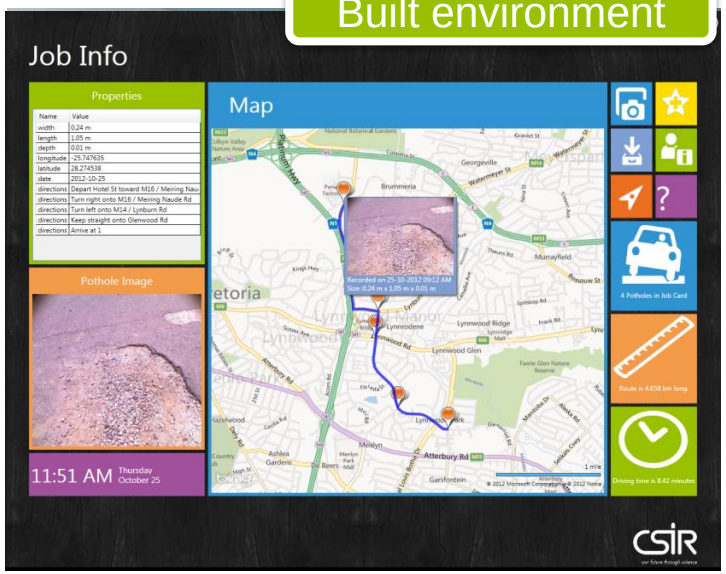
Outcome

- Marine protected area declared April 2013
- Types of protected zones: no fishing; restricted; controlled
- Protection of fish stocks and habitat for some animals that occur nowhere else in the world

CSIR
our future through science

New tool to help authorities address road degradation

Built environment



The challenge

- Real-time information on roads (and degradation) and tools to aid decision-making on repair
- Current management process is manual, tedious

The research and development

- Hardware and imaging software solution developed
- Detection through scanning sensors mounted on a vehicle and driving up to 80 km/h
- After detection of degradation: plots onto a map; outlines repair requirements; costs restoration
- Repair teams can be deployed based on system-generated job cards
- Real-time and historic information can be mined

Outcome

- Validation of services provided by local government

CSIR
our future through science

ICT at work for education

Education

The challenge

- Rural schools have limited access to Internet and educational resources

The research and development

- Demonstrate how technology can support rural schools in Cofimvaba school district
- Test efficacy of teaching and learning with tablets; develop models for replication
- Wireless Internet network developed and installed in Limpopo, Mpumalanga, Northern Cape and Eastern Cape
- Online math tutoring through Mxit, 40 000 users
- Digital Doorway redesigned to accommodate printers, tablets, and a screen incorporated into one side wall of the container.

CSIR
our future through science

A new diamond cutting and polishing business takes shape

Enterprise creation for development

The challenge

- Sustainable rural livelihoods in the North West diamond beneficiation sector

Technology solutions and enterprise creation

- Investigated most viable business opportunity
- Formulated business plan addressing e.g. issues on purchasing of rough diamonds; setting up of modern diamond processing facilities; training for diamond cutting and polishing of rough diamonds
- Six months' training at Harry Oppenheimer Diamond Training School completed
- CSIR to be involved for next two years

Outcome

- A new diamond cutting and polishing facility in Wolmaransstad is ready for operation

CSIR
our future through science

The CSIR remains committed to research, development and innovation for national benefit …

our future through science

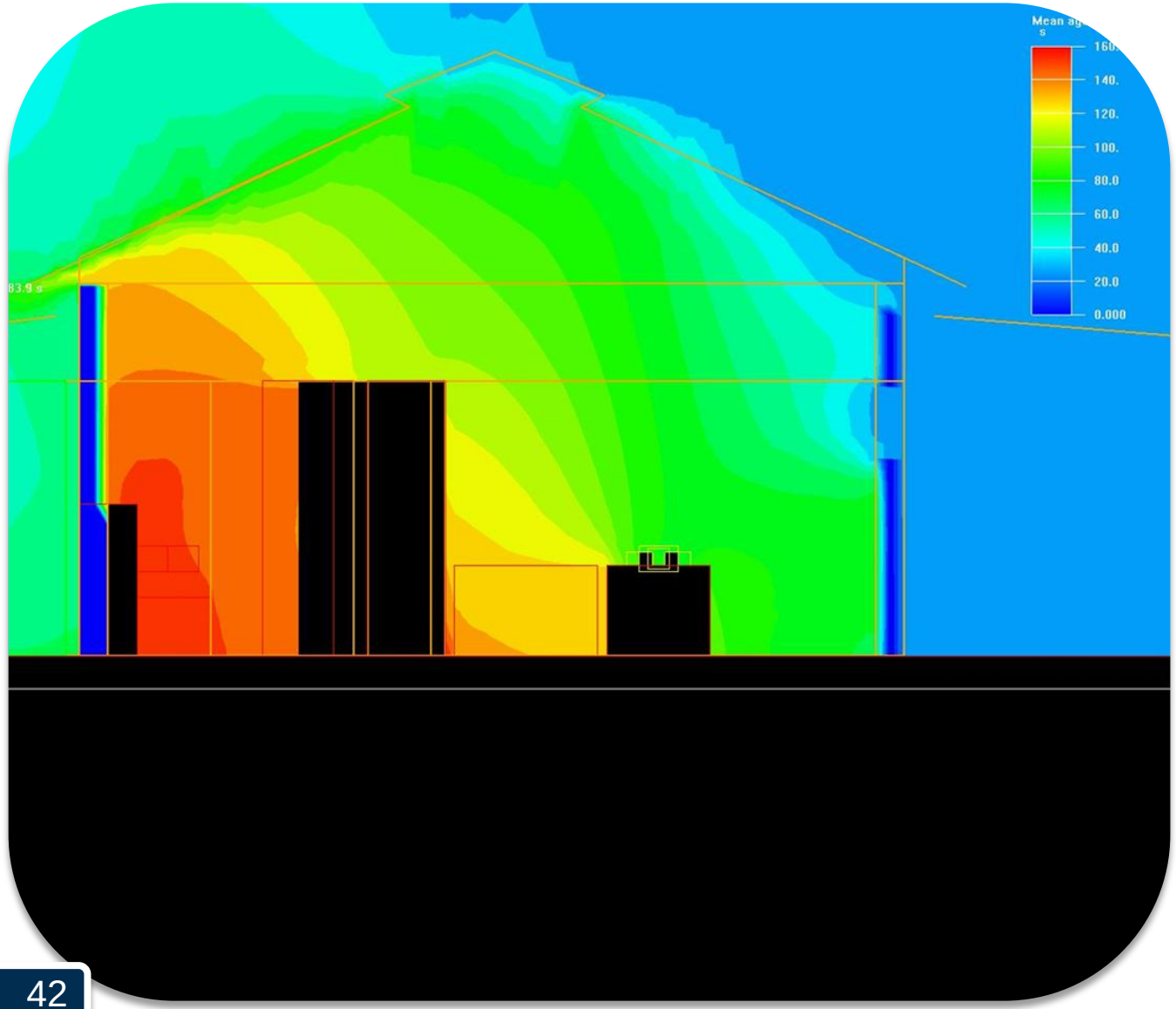
…whether it is through helping to curb crime through a system that foils cash-in-transit heists using a foam that hardens in seconds;

…creating sustainable businesses such as the *Rose Geranium* cultivation and distillation project in KwaNobuhle;

…developing a laptop computer for the blind;

…helping to bring solutions to water-related problems in South Africa to communities;

CSIR
our future through science



…improving the architectural design of hospitals to limit the spread of tuberculosis;

…or through a low-cost Doppler ultrasound device that assesses a foetus considered small for gestational age.

Thank you

our future through science