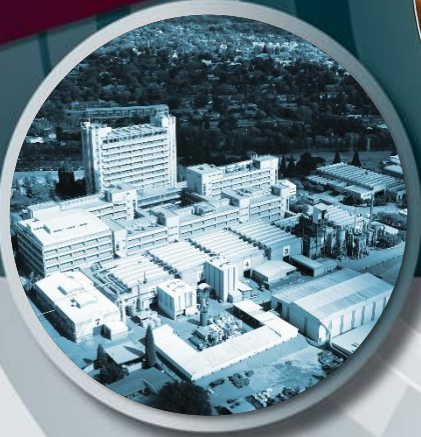


# Mintek Annual Corporate Plan 2022/23



Molefi Motuku, PhD

|

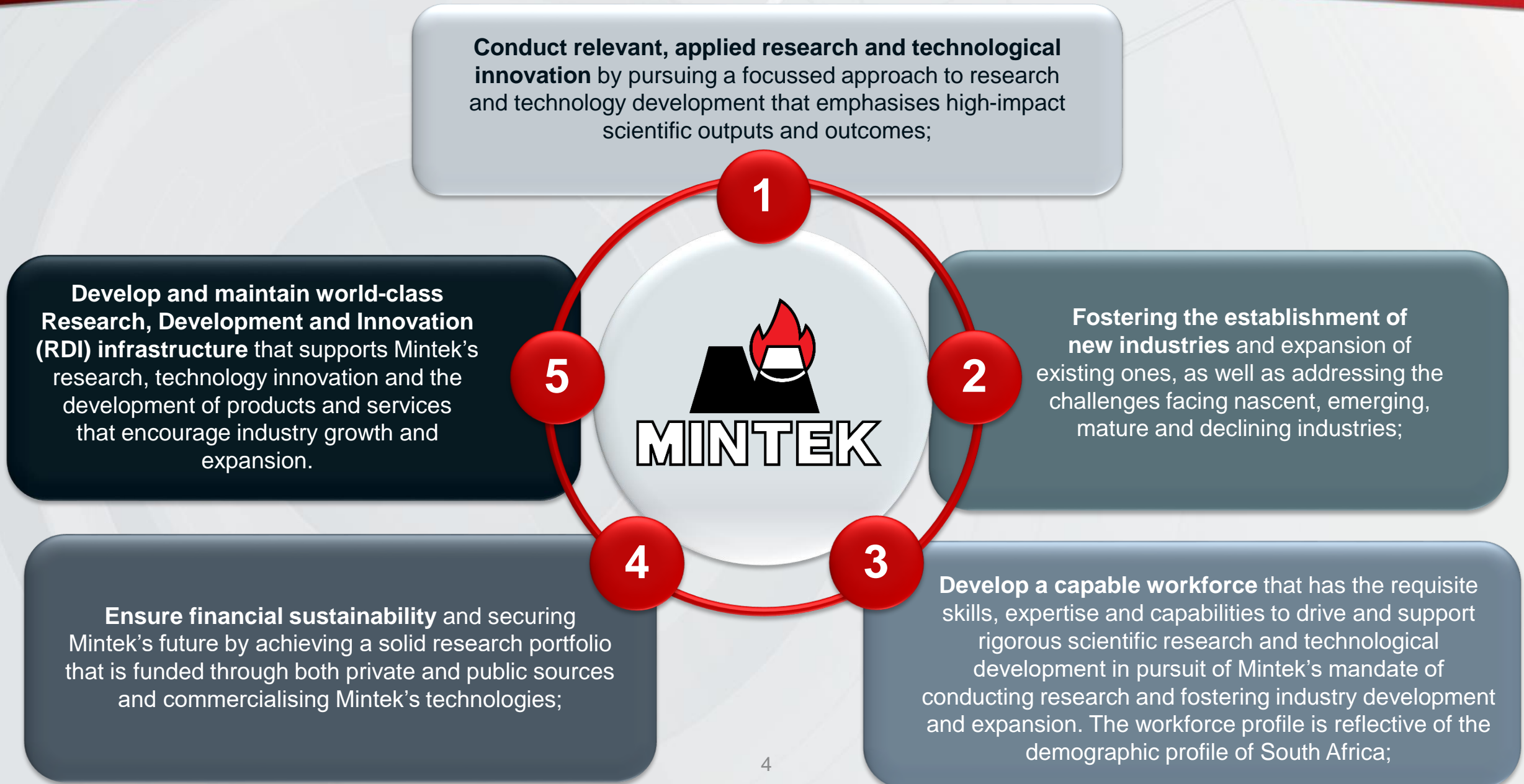
26 April 2022

# Outline

- Mintek at a glance
- Mintek corporate scorecard, 2022/23
  - ✓ Learning and growth perspective
  - ✓ Research, development and innovation perspective
  - ✓ Industry development
  - ✓ Develop and maintain world-class research, development & innovation capacity
  - ✓ Financial perspective
- Concluding remarks

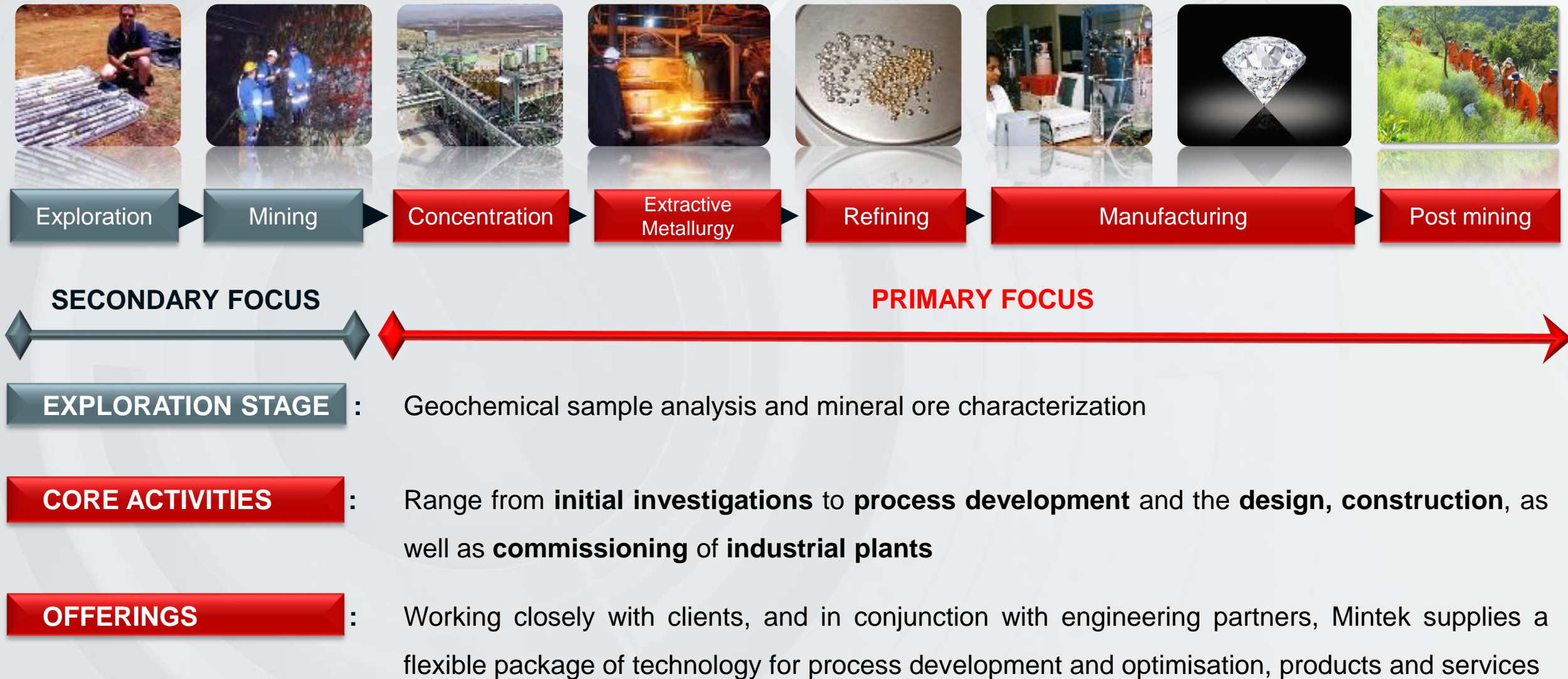
# Mintek at a Glance

# About Mintek – how we operate















# MINTEK: focus areas along the mining & minerals value chain



# Mintek's global operations



 Gold	 PGMs	 Ferrous Metals	 Equipment & Technology	 Base Metals
 Industrial Minerals & Diamonds	 Process Control Strategies	 Uranium	 Rare Earth Elements	 Economic & Regional Structures



- Planning process for the 2023/2025 MTEF period was conducted during Q4 2022.
- Most of our models, assumptions and projections were based on current information regarding the market amidst the Covid19-pandemic.
- Industry in general is under severe financial strain due to the pandemic.
- Restrictions on local and international movements affects our ability to receive samples for analysis, offer piloting services and visit sites/facilities to service operations.
  - Mintek's ability to earn local and foreign income is thus significantly hampered.



# Mintek at a Glance: 2021/22 (*preliminary results*)



EMPLOYEES COVID TESTS TO DATE: **7 257** & EMPLOYEES SCREENING TO DATE: **244 906**

## Learning and Growth



Total staff base: **532**  
SET base: **237 (45%)**  
SET Mid-Senior staff: **103 (43%)**



Black SET: **182 (77%)**  
Female SET: **116 (49%)**  
% SET Black Mid-Senior staff: **65 (63%)**



SET - PhD: **59 (25%)**  
SET - MSc: **51 (22%)**  
PhD studies: **13**  
MSc studies: **55**

## Financial Perspective



Products & Services: **R146.2 m**  
Total income: **R593.4 m**  
Total expenses: **R567.7 m**  
Deficit/Profit: **R25.7 m**



Investment in R&D: **R260.7 m**  
Investment in PPE: **R20.7 m**  
Investment in HCD: **R9.1 m**  
Staff turn-over: **10.5 %**



BEE Spent: **103.32%**  
Liquidity ratio: **1.5:1**

## Research, Development & Innovation



Journal papers: **61**  
Conference papers: **36**  
Books chapters: **9**  
Books: **0**



New trademarks: **3**  
Certified reference materials: **6**  
Accredited methods: **17**  
Accredited facilities: **3**



New patents: **0**  
Invention disclosures: **8**  
IP Licence agreements: **0**  
New technologies/prototypes: **14**



# Mintek at a Glance: 2022/23 Targets

## Learning and Growth



Total staff base: **532**  
SET base: **240 (45%)**  
SET Mid-Senior staff: **118 (49%)**

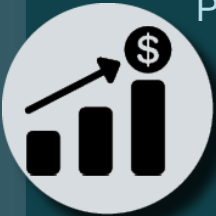


Black SET: **193 (80%)**  
Female SET: **132 (55%)**  
% SET Black Mid-Senior staff: **97 (82%)**



SET - PhD: **61 (26%)**  
SET - MSc: **79 (34%)**  
PhD studies: **15**  
MSc studies: **58**

## Financial Perspective



Products & Services: **R123.7 m**  
Total income: **R590.1 m**  
Total expenses: **R587.7 m**  
Deficit/Profit: **R2.4 m**



Investment in R&D: **R285 m**  
Investment in PPE: **R47.9 m**  
Investment in HCD: **R11.8 m**  
Staff turn-over: **10 %**



BEE spent: **90%**  
Liquidity ratio: **1.6:1**

## Research, Development & Innovation



Journal papers: **61**  
Conference papers: **36**  
Books chapters: **9**  
Books: **0**

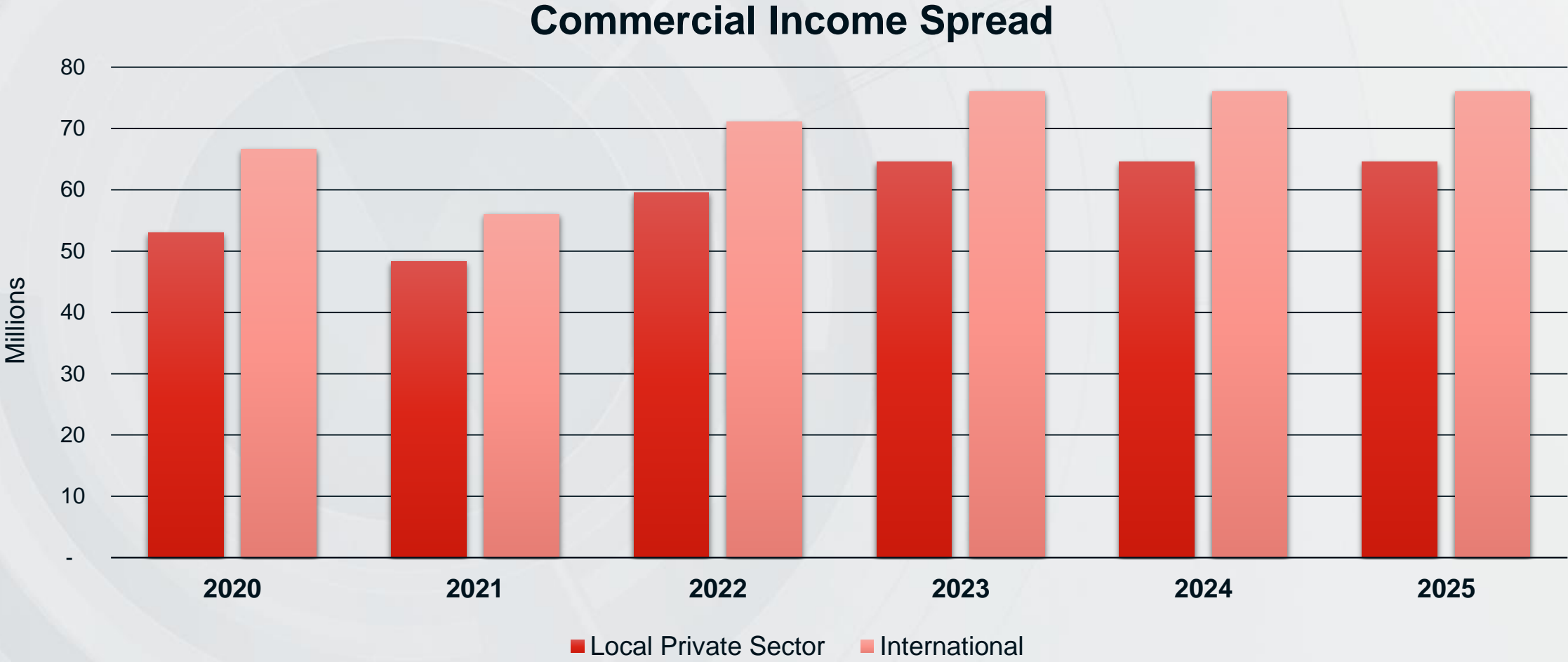


New trademarks: **5**  
Certified reference materials: **4**  
Accredited methods: **20**  
Accredited facilities maintained: **5**



New patents: **4**  
Invention disclosures: **10**  
IP Licence agreements: **1**  
New technologies/prototypes: **15**

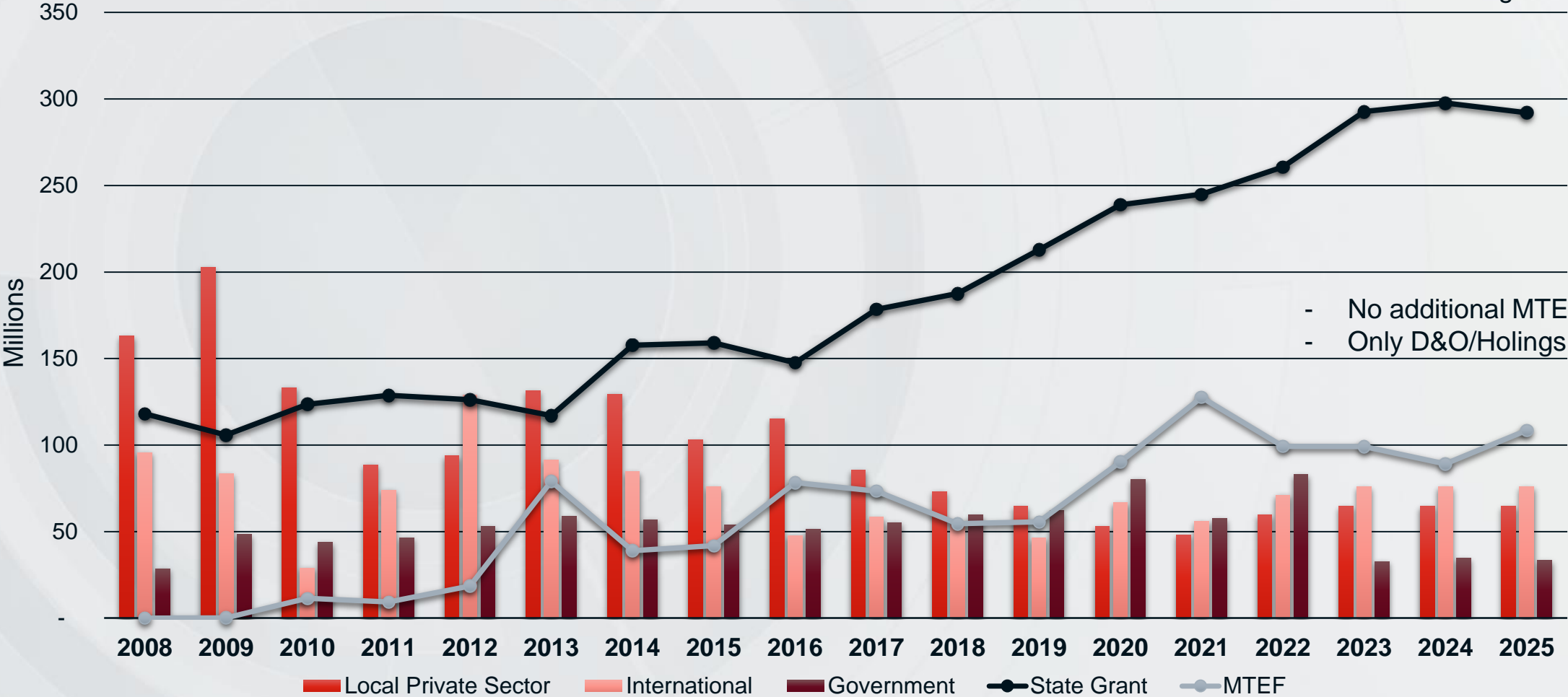
# Key challenges and risks



# Revenue Sources

## Income Distribution

- Increased reliance on state funding while commercial revenue remains stagnant



- No additional MTEF  
- Only D&O/Holings



# Mintek Corporate Scorecard 2022/23

# Learning and Growth Perspective



# Key Performance Indicators for 2022/23



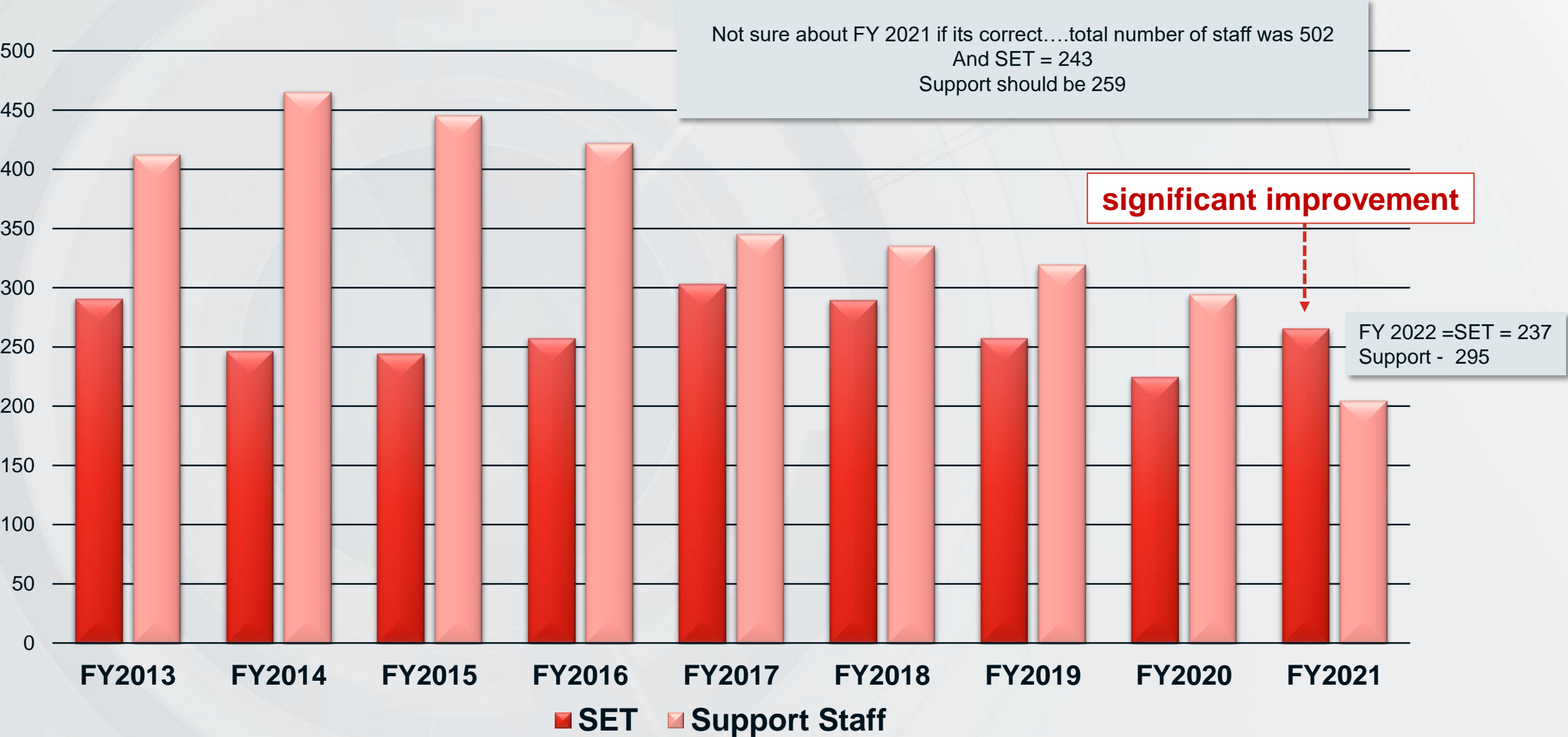
Strategic Outcome - Oriented Goal	Key performance indicators	Actual 2020/21	Target 2021/22	Actual (preliminary) 2021/22	Target 2022/23
<b>Develop a capable workforce</b>	Total number of SET employees	243	220	237	240
	Percentage of SET staff	80%	80%	77%	80%
	Percentage of female SET staff	53%	52%	49%	55%
	Total number of SET staff with doctoral degrees	46	55	59	61
	Percentage of SET staff with doctoral degrees	19%	25%	25%	26%
	Total number of SET staff with master's degrees	54	70	51	79
	Percentage of SET staff with master's degrees	22%	32%	22%	34%
	Total number of SET staff at middle and senior levels (SP, MP and SE)	98	115	103	118
	% of black SET staff at the middle and senior levels (SP, MP and SE)	63%	65%	63%	82%

# Employment Statistics

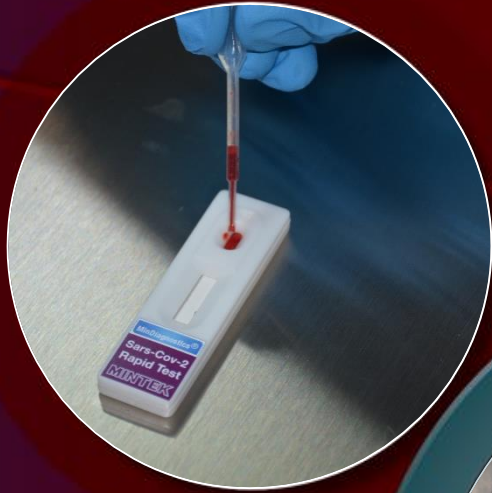
Occupational Levels	MALE					FEMALE					Grand Total
	African	Coloured	Indian	White	NSA	African	Coloured	Indian	White	NSA	
Top Management	3		1			0	0	0	1		5
Senior Management	5		0	2	1	3	1	1	1	1	15
Professional, qualified and experienced specialist	20	2	3	12	5	17	1	3	6	3	72
S. tech, Ac. quali. work, Jun. manage, Su	89	4	2	17	8	131	5	5	12	2	275
Semi-skilled and discretionary decision	68	4	0	1		22	1	0	0		96
Unskilled and defined decision making	49	1	0			19	0	0	0		69
Total Permanent	234	11	6	32	14	192	8	9	20	6	532
Percentage	44%	2%	1%	6%	3%	36%	2%	2%	4%	1%	100%
Gender percentage	56%					44%					



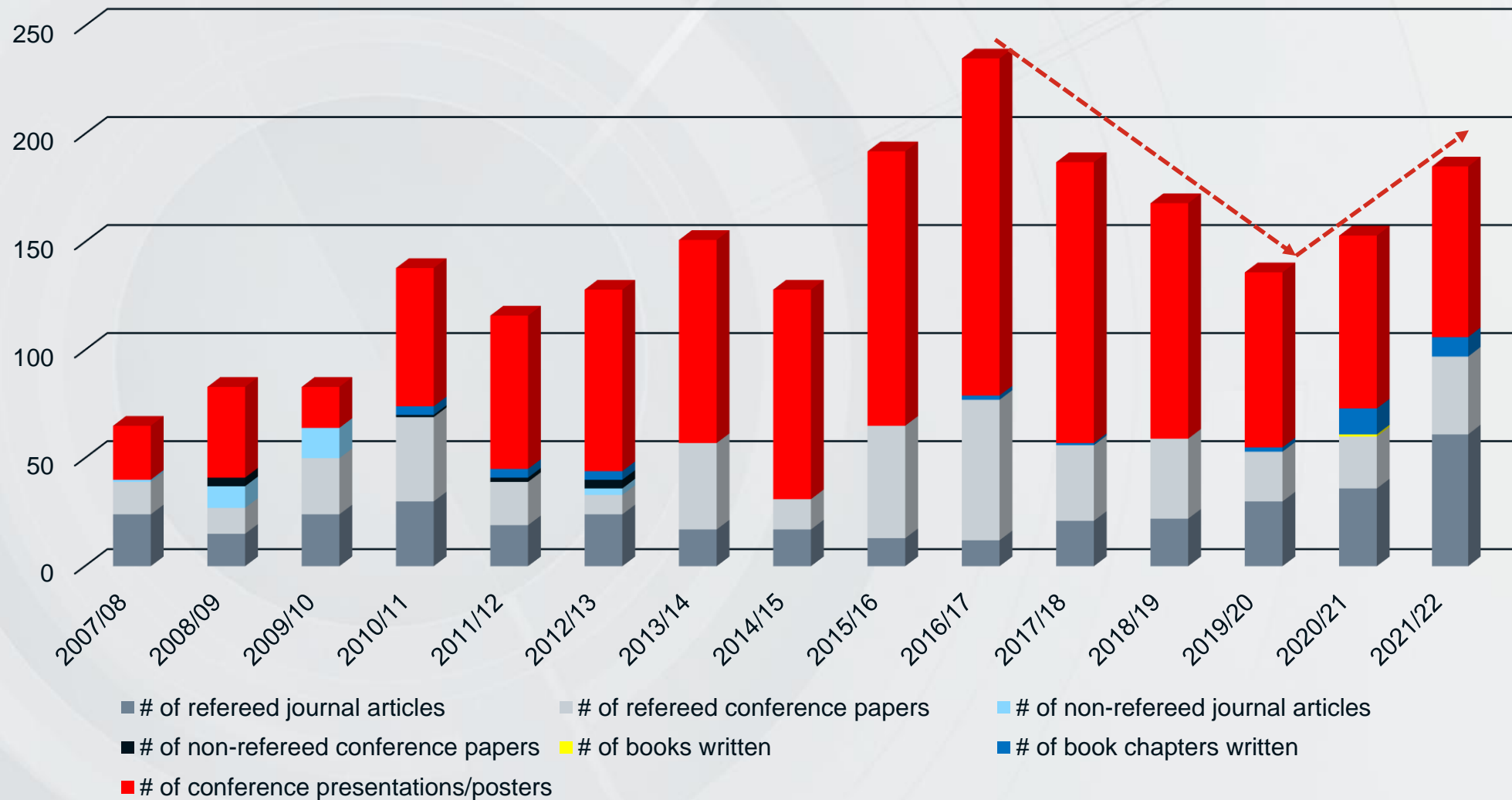
# SET vs Support staff



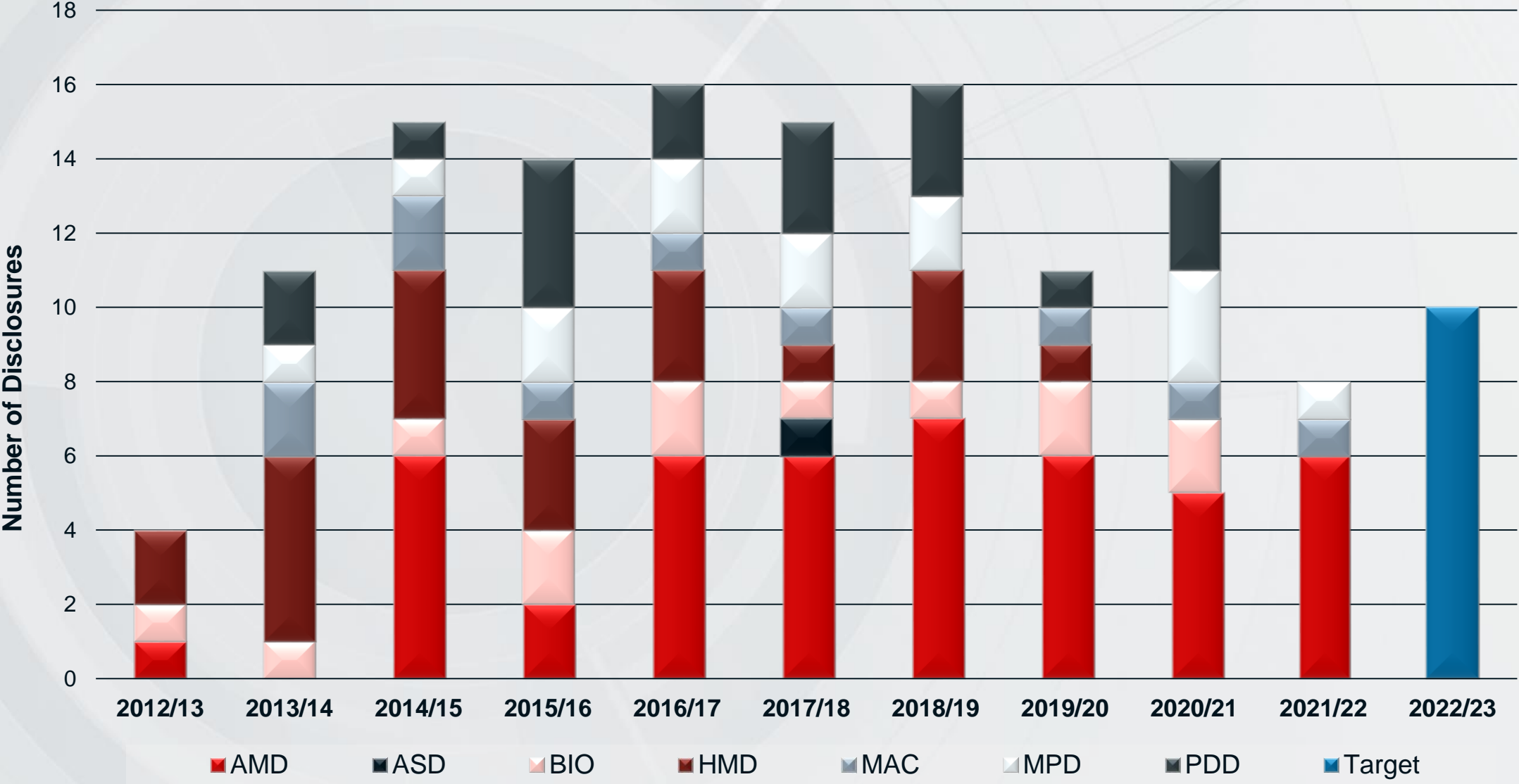
# Research, Development and Innovation Perspective



# Knowledge dissemination: publications by type



# Invention disclosures





# Invention disclosures

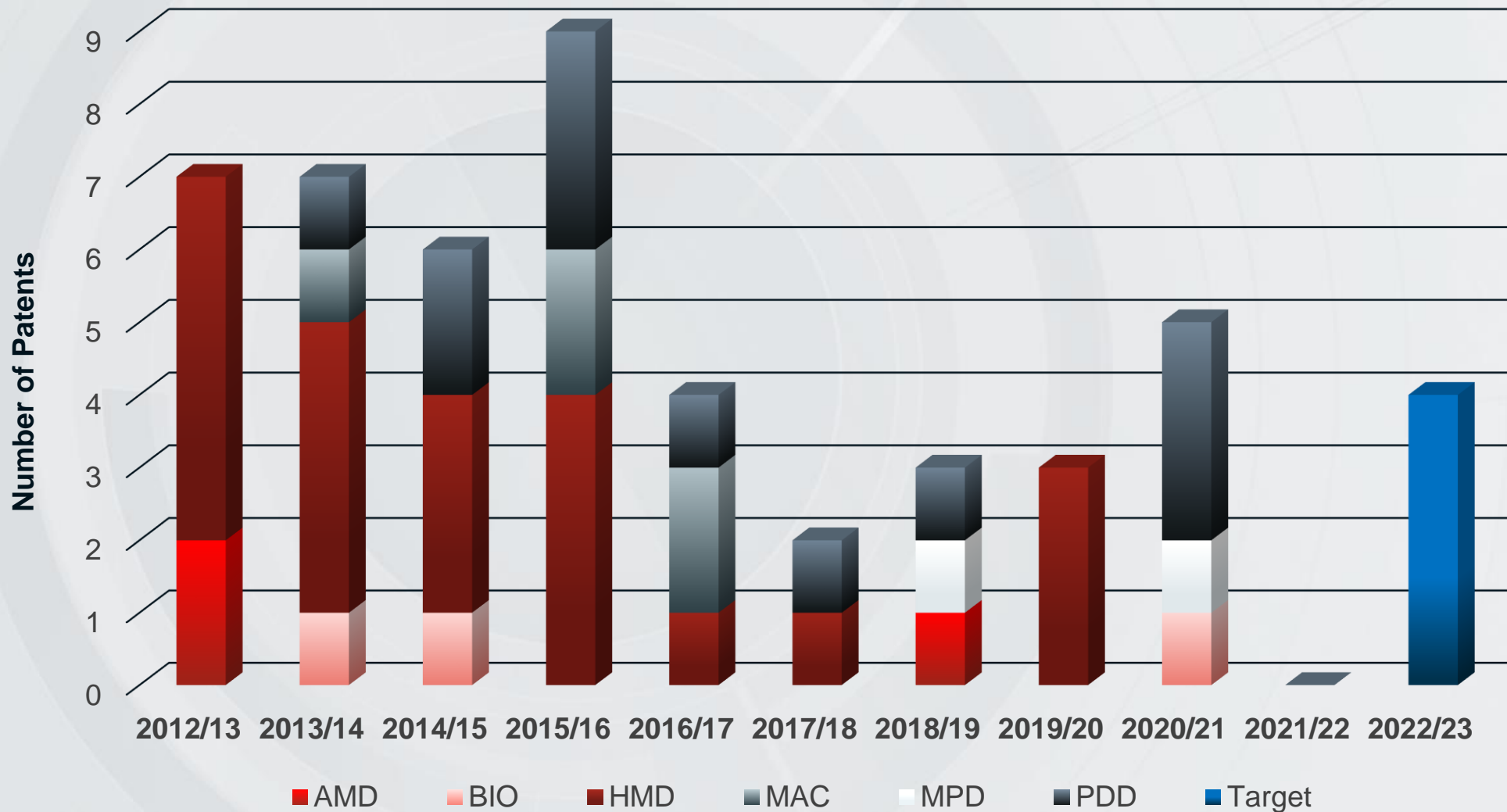
Over the past 10 years Mintek has filed 123 invention disclosures and 46 provisional RSA patents applications.

• In 2021/22 Mintek filed 8 invention disclosures, these include:

- **Platchem Technology**
- **Continuum-armed bandit** for optimising minerals processing operations
- Development of the **SARS-CoV-2—Opt—NanoSilver photoluminescence nanobiosensor** for the detection of SARS-Cov-2 viral particles
- Design and production of a **recombinant HIV-1/HIV-2 fusion antigen Synthesis of Panni nanoframes via thermal reduction**
- The Development of **PtCo/C Electrocatalysts for Hydrogen Proton Exchange Membrane Fuel Cells at Commercial Scale**
- The Scale-up of **Pt/C Heat Stabilized Fuel Cell Catalysts**
- **Alginate-based nano-adsorbent resin** for removal of heavy metals in aqueous solutions



# Patents



**Mintek registered 46 provisional RSA patents over the period 2012-2021**

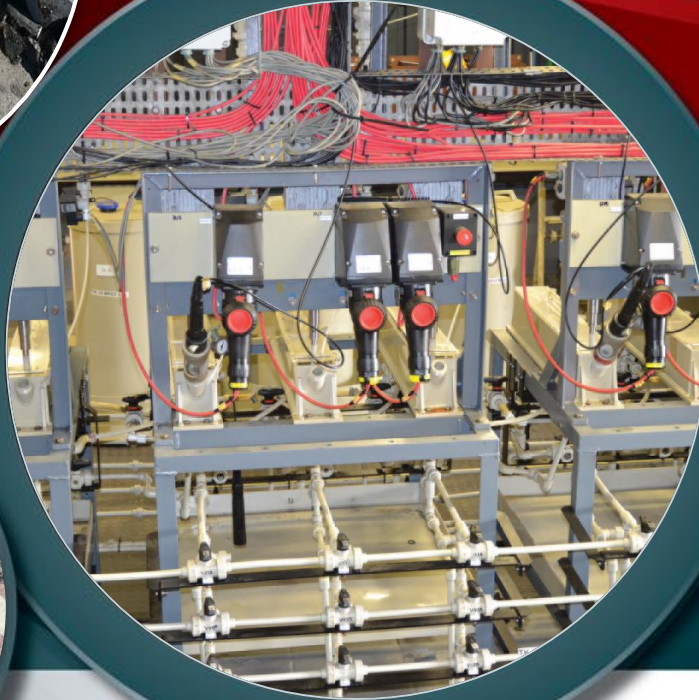
- In 2021/22 Mintek registered no new patents. New invention disclosures were reviewed for patentability, none of them currently meet the patenting criteria and are kept as trade secrets.

# Key Performance Indicators for 2022/23



Strategic Outcome - Oriented Goal	Key performance indicators	Actual 2020/21	Target 2021/22	Actual (preliminary) 2021/22	Target 2022/23
<b>Conduct relevant, Applied research And technological innovation</b>	Number of journal papers	36	30	61	40
	Number of conference papers	24	35	36	40
	Number of book chapters	12	5	9	5
	Number of books	1	1	0	1
	Number of invention disclosures	13	16	8	10
	Number of new patents	5	4	0	4
	Number of new trademarks	5	6	3	5
<b>Foster industry establishment and expansion</b>	Number of new products, services, prototypes, processes and/or models demonstrated/ validated in a relevant environment	12	20	14	15
	Income from the sale of products and services, royalties and licences (R million)	103.04	108.78	146.19	123.7
	Number of IP licences	0	1	0	1
	Number of certified reference materials	-	6	6	4
	Number of accredited methods developed and maintained	-	19	17	20

# Industry Development Perspective





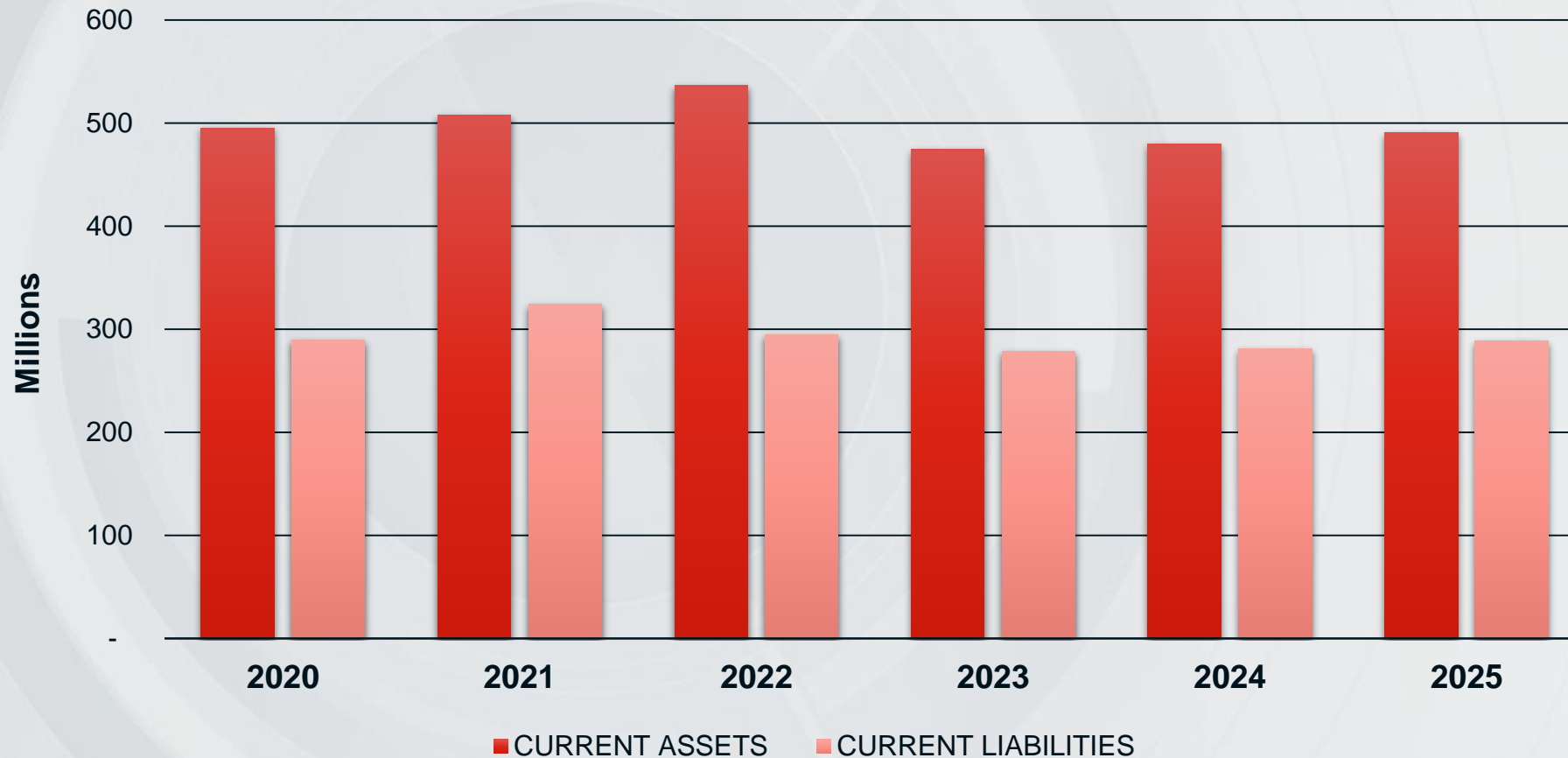


- 1 Establishing a **Rare Earth (REE) Industry** in South Africa
- 2 Establishing **Medical Diagnostic Manufacturing** capability in South Africa
- 3 Revival of the **Ferroalloys Industry** in South Africa
- 4 Incubating **Fuel Cell Manufacturing at Mintek**
- 5 **Energy Storage** as an Enabler of a **Just Energy Transition**
- 6 **Coal Gasification**
- 7 Revitalising South Africa's **Iron Ore Industry**
- 8 Unlocking the **Bushveld Complex's Titaniferous Magnetite**





## Current assets vs Current liabilities

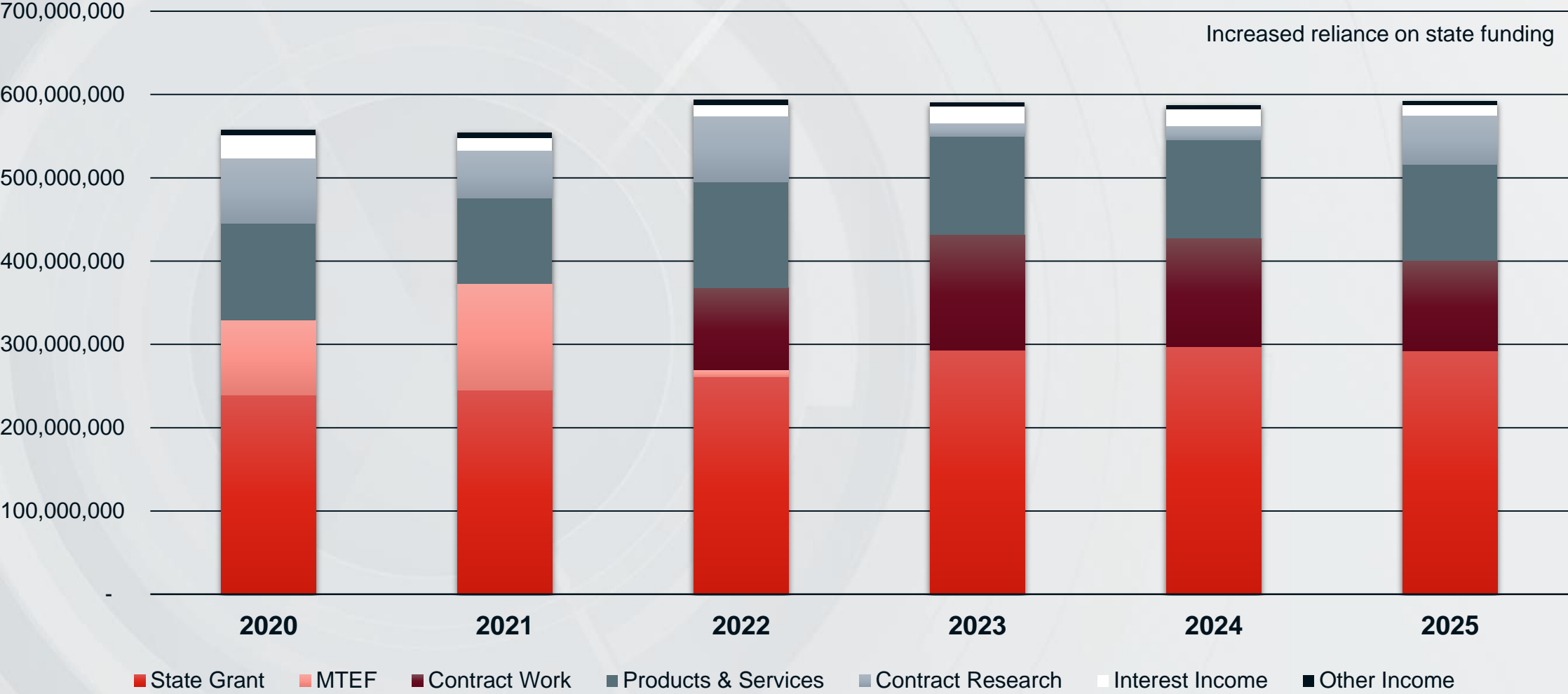


Cash locked up in working capital is a continuous focus area for Mintek. The **current ratio** improved to **1.8:1**

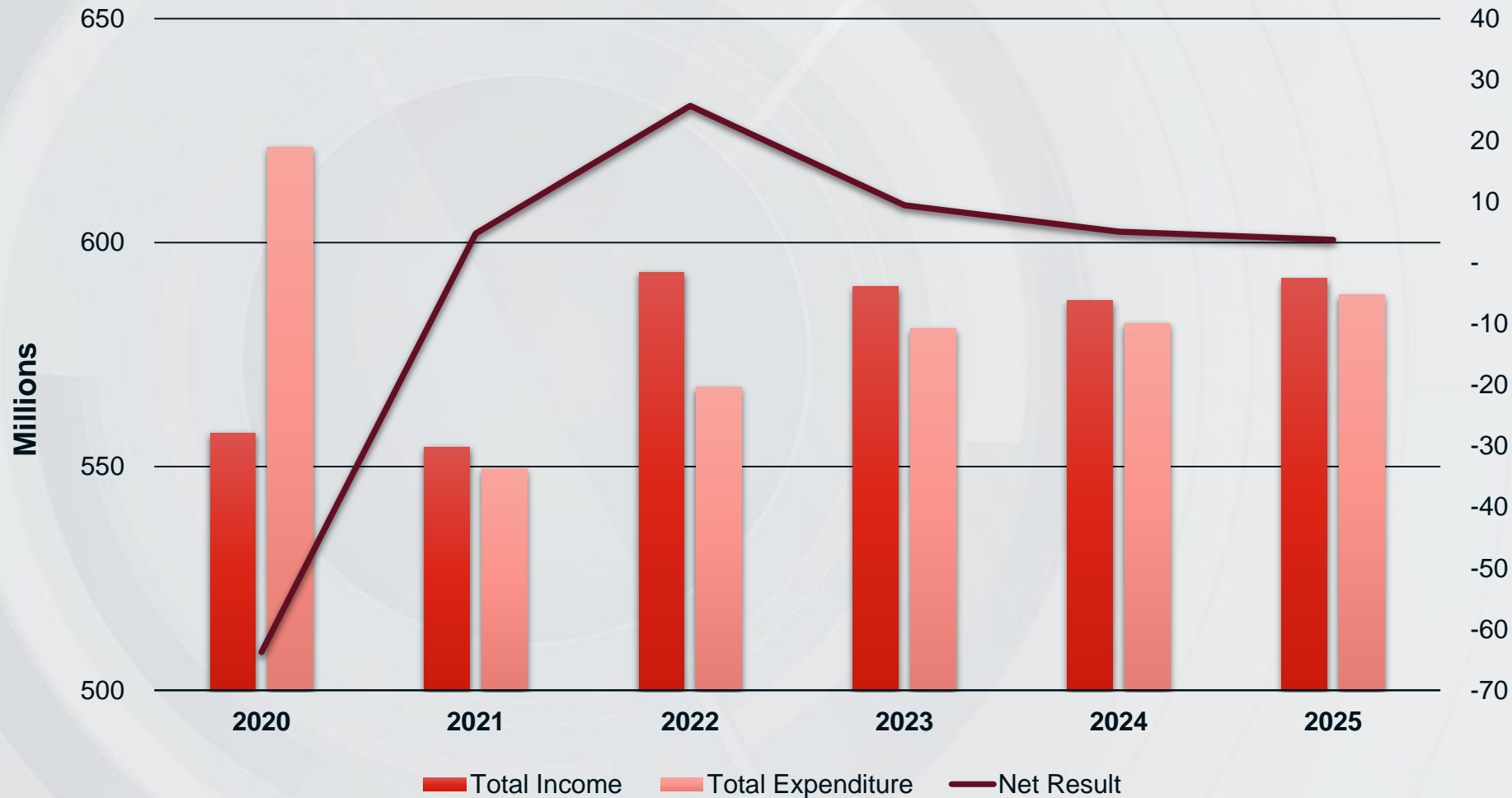
The ratio indicates that Mintek's short term obligations were adequately covered by current assets

*\* 2022 results based on preliminary figures*

# Revenue Sources



# Income vs Expenditure

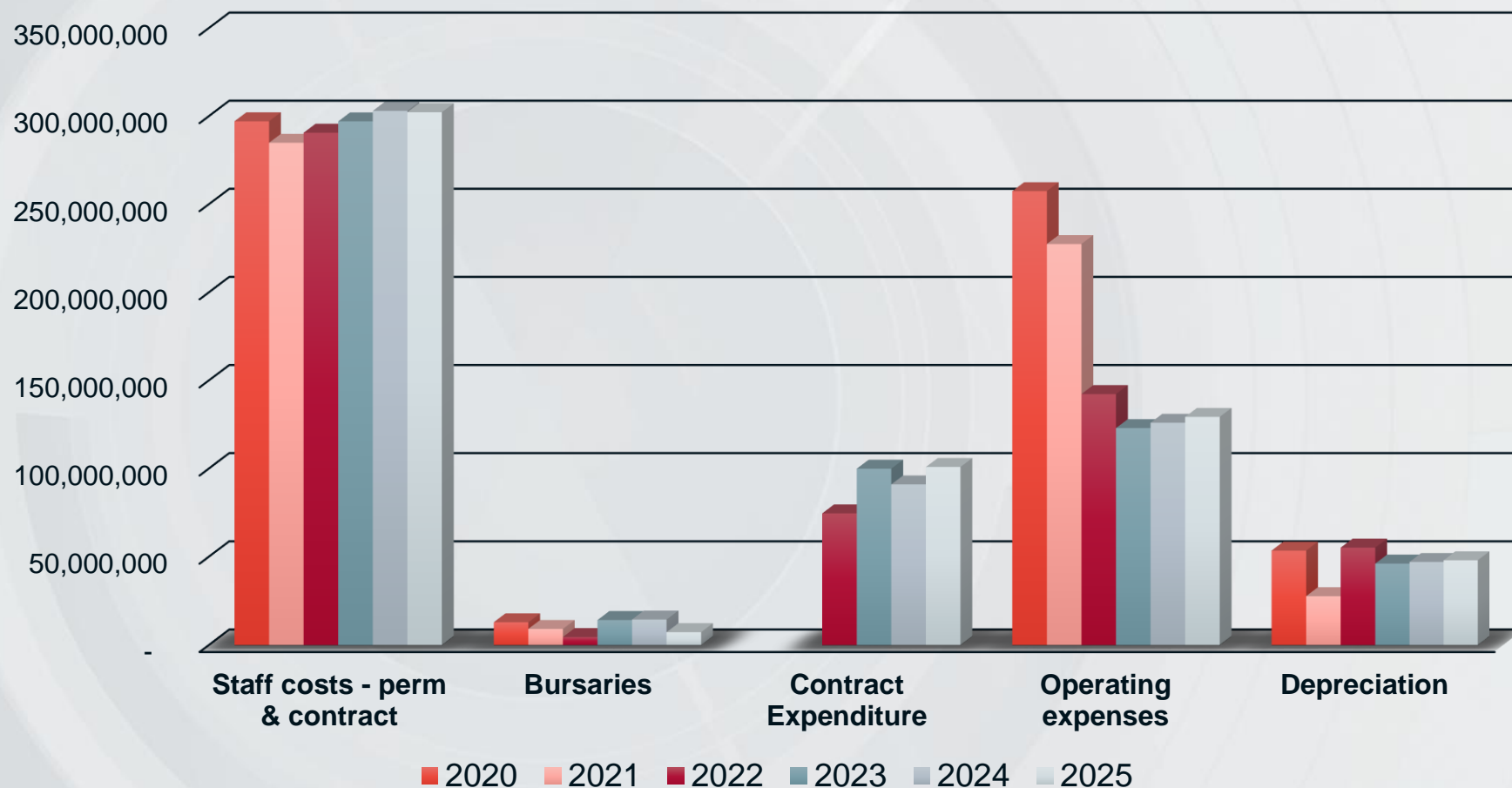


- **Estimated surplus of R25.7m predicted for 2022 with a decreased surplus planned for 2023**
- **Achievement of 2023 revenue target will be dependent on recovery of market**

*\* 2022 results based on preliminary figures*



# Expenditure Analysis



- **Contract expenditure** disclosed separately from 2022. Previously part of operating expenditure.
- Relates to costs incurred for **Contract Revenue** (In/Out)
- 2% increase expected year-on-year for MTEF period.

*\* 2022 results based on preliminary figures*



## Employee cost as % of total expenditure



- Single largest contributor to costs is **staff cost**.
- Maintained around 54%
- Inflationary increases for last few years only.
- No incentives/bonuses paid.

\* 2022 results based on preliminary figures

# Audit opinion history



2005	Disclaimer			
2006		Qualification		
2007			Unqualified with Findings	
2008			Unqualified with Findings	
2009				Unqualified (Clean)
2010				Unqualified (Clean)
2011				Unqualified (Clean)
2012				Unqualified (Clean)
2013				Unqualified (Clean)
2014				Unqualified (Clean)
2015			Unqualified with Findings	
2016				Unqualified (Clean)
2017				Unqualified (Clean)
2018				Unqualified (Clean)
2019			Unqualified with Findings	
2020			Unqualified with Findings	
2021			Unqualified with Findings	

# Concluding

- Mintek is in a transition phase **to fully align with our role as a research and technology organisation**, as well as an industry-focused research institution.
- We are implementing a new strategy that has already begun to deliver results with an improvement in the SET staff numbers, experience and qualification profile.
- Mintek is **building capacity in business development and commercialization** as well as **communication**.
- Rehabilitations projects were suspended due to **ongoing community protests**
- **Declining public and private sector investment in Research & Development is a major concern**
- **Mintek is 87 years old, recapitalization** is required to create Mintek RDI campus of the future
  - Mintek key capabilities are centered around **large scale pilot, testing and demonstration facilities** that are expensive to establish and maintain.
  - Buildings and research infrastructure **upgrades** have already commenced
- Overall, Mintek performed satisfactorily amidst the challenges posed by COVID 19 pandemic.



# Thank You

A global leader in mineral and metallurgical innovation

## **MINTEK CONTACT DETAILS**

200 Malibongwe Drive, Randburg, South Africa | Private Bag X3015, Randburg, 2125, South Africa

Tel: +27 11 709 4111 | [www.mintek.co.za](http://www.mintek.co.za)



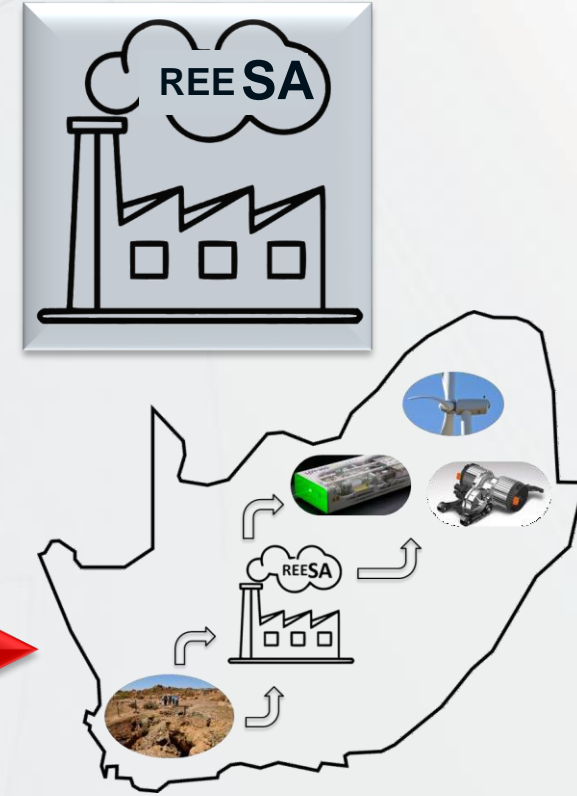
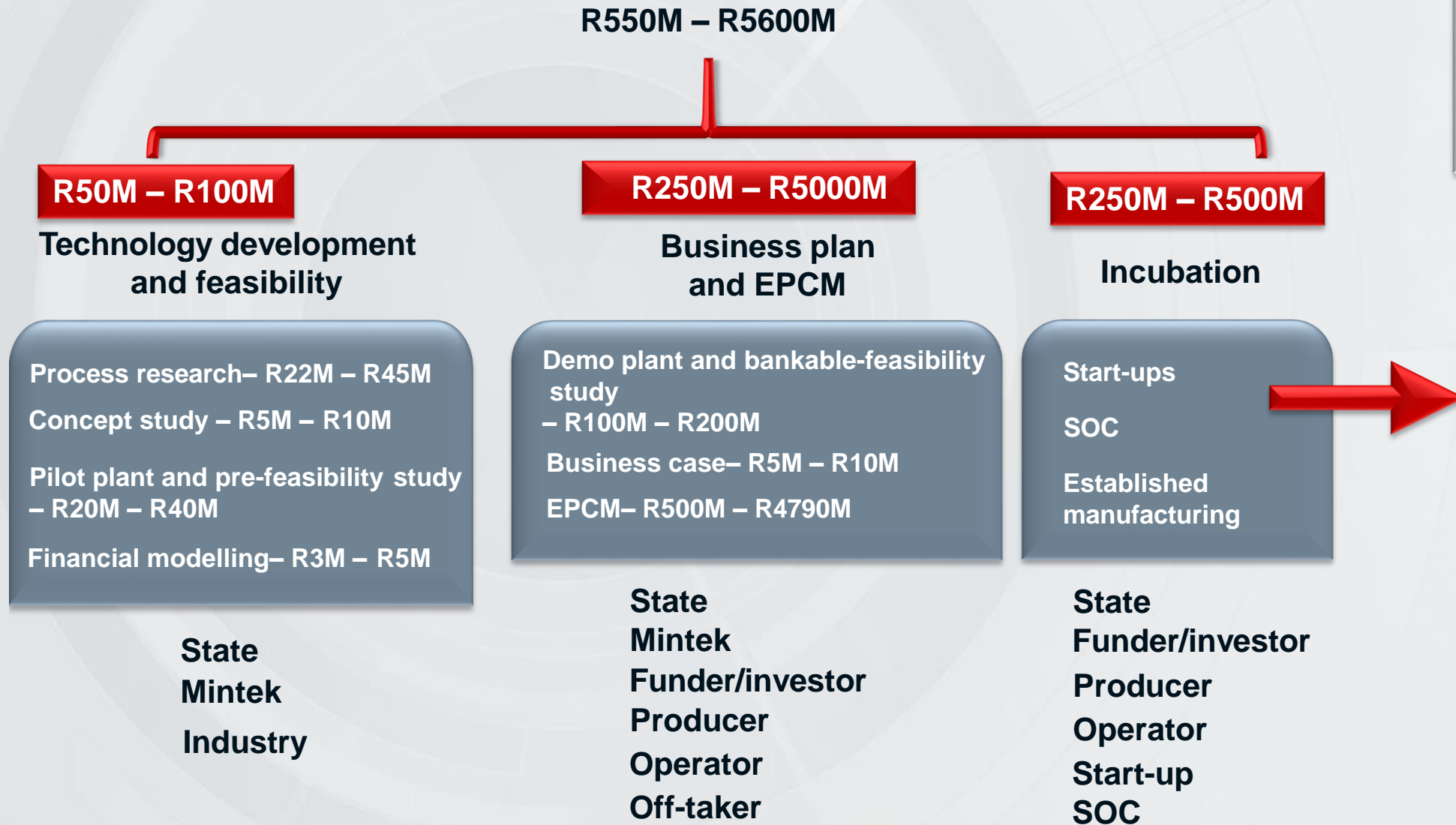
# Required Support for Mintek Strategic and National Programs



- **Policy imperatives of industry revitalisation prioritised**
  - Ferro-alloy and Rare Earth Elements
- **Strategic Programmes**
  - Establishing a Local Rare Earth Element Mining and Manufacturing Industry,
  - Development of rapid diagnostic medical test kits,
  - Expanding fuel cell manufacturing infrastructure across the fuel cell value chain and
  - **e-waste recycling.**
  - **Design, procurement and construction** of a manufacturing facility for the production and establishing **ferro-alloy research program** with support from industry.
  - Revive the declining ferroalloys sector – mainly ferrochrome and ferromanganese
- **Cost pressures to launch new programmes** where research projects are expanded to the next level.

# Establishing a Rare Earth Industry in South Africa

**HOW?** – *will all this be achieved?*



# Battery precursor metals in South Africa



Electric vehicles  
Smart-grid storage  
Portable electronics



Electric cars, hard drives  
Wind turbines  
High-tech industries

## Fluorspar

- Electrolyte for lithium ion batteries

1<sup>st</sup>

## Manganese

- Cost-effective cathode for Li-ion batteries

1<sup>st</sup>

## Vanadium

- Flow batteries

2<sup>nd</sup>

## Titanium

- Advanced anodes for Li-ion batteries

4<sup>th</sup>

## Nickel

- Advanced cathodes for Li-ion batteries

5<sup>th</sup>

## Phosphate

- Electrolyte for Li-ion batteries

6<sup>th</sup>

## Rare earth elements

- Permanent super magnets

L

SA reserve size vs global

A specific feature of these battery precursor metals is **exceptional purity**.



## Technologies

## Precursors

5-15 years

2-7 years

R50M – R100M

R250M – R1,250M








Technology development

Construction & commissioning

Feasibility and design studies

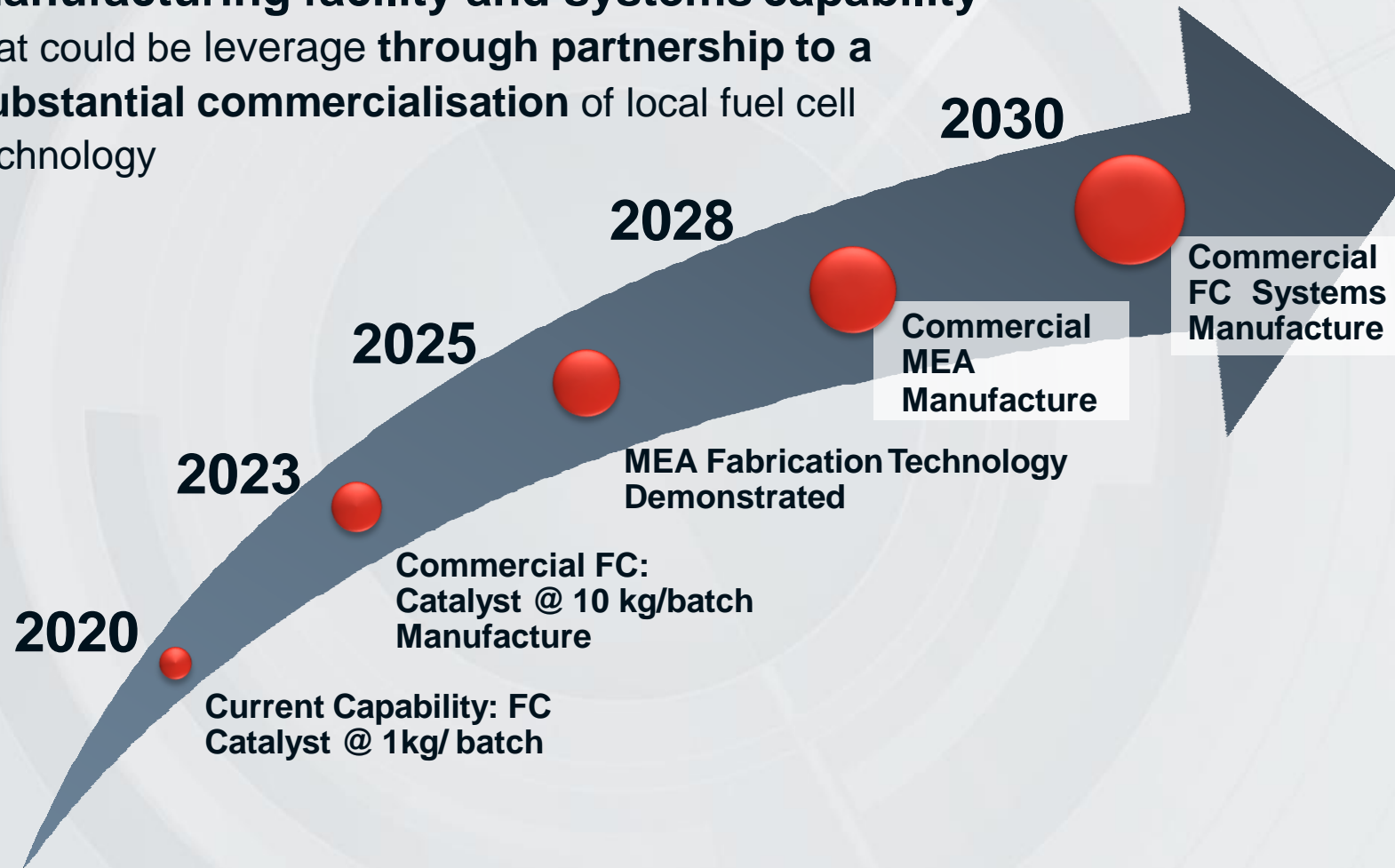
Towards production

-  Mintek
-  Partners
-  State
-  Regulators
-  Funder / investor
-  Producer
-  Implementer



# Commercialisation of Mintek Fuel Cell Technologies

Establish and demonstrate a **commercial MEA manufacturing facility and systems capability** that could be leverage through partnership to a **substantial commercialisation** of local fuel cell technology



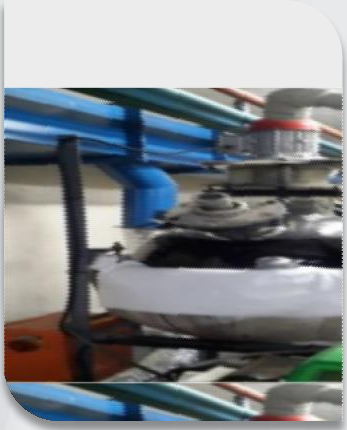
INVESTMENT SOURCE	Total 2020 – 2030, Rm
HySA	20
Mintek	200
MTEF	270
Partners (10:1 leverage)	5010
Total for 5% market penetration	5500

**HySA target of 25% for FC systems  
~R29.6b revenue equivalent to  
~17000 jobs in 2030**

**More realistic 5% for FC systems,  
~R6b revenue & 3600 jobs**

New investment over the decade would need to approach a cumulative \$325m which could potentially represent a 10:1 gearing of the Mintek investment (~R500m by 2030 obtained from HySA, Mintek and MTEF) by collaborating partners and other commercial entities in South Africa that could use the Mintek products.

# Fuel Cell catalyst scale-up for commercialisation



## Bay 6.5

- 1 kg/batch scale
- 10 batches per year
- Enabled by **Impala 7kg Pt loan**

**To 2023**



## Bay 5 (Catalyst Plant)

- 5-10 kg/batch scale
- +10 batches per year (with dedicated production staff)
- **Needs new Pt loan to do development**
- Addressable issues: filtering, milling, heat treatment (capex needed)
- Critical issues: source graphitized C or capex for large 2000°C furnace
- **High security needed**

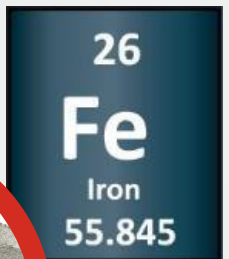
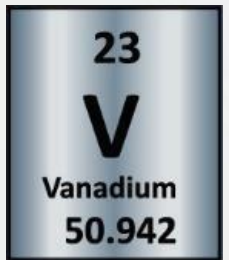
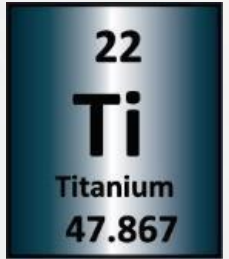
**Beyond 2023**

**50 kg/batch  
New Plant**

- Guaranteed demand
- **New facilities**
- **Alternative site**
- **Investment**

# The Bushveld Complex's VTM – background

- The Bushveld Complex: PGM and chrome rich layers, and vanadiferous magnetite layer contain vast proportions of the World's deposits of these commodities.
- VTM (vanadium-bearing titaniferous magnetite) contains **vanadium (V)**, **titanium (Ti)**, and **iron Fe** as magnetite.
- All these elements are in a complex oxide form (requires a thermo-chemical extraction process) – needs energy and chemical reactions to extract
  - Since closure of EVRAZ Highveld Steel in 2015 only small activity to extract vanadium
  - About 90% of the world's vanadium production was recovered from the titanomagnetite resources (2019) – mainly in China
  - SA has second largest vanadium reserve globally in Bushveld Complex



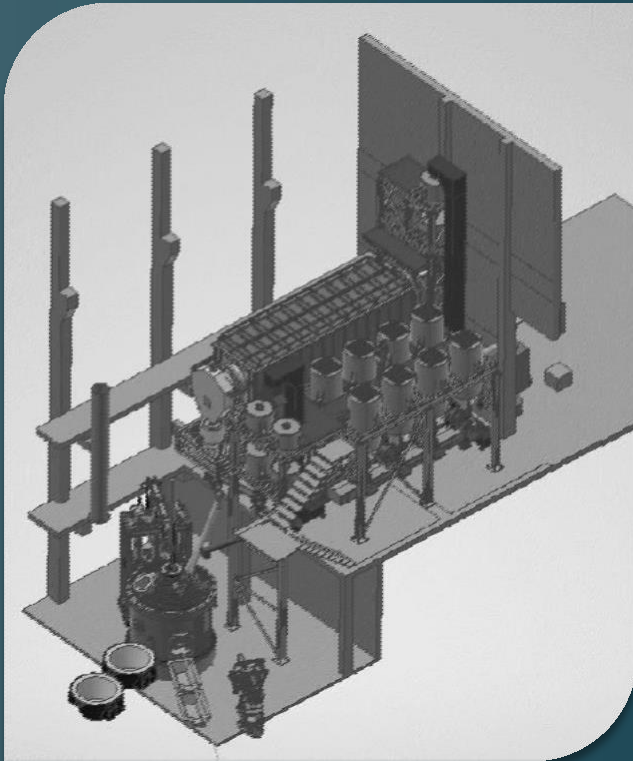
# Establishing a VTM smelter in South Africa

**HOW?** — *will all this be achieved?*

***Implementing the best available technology***

**R116 million MTEF**

Demonstration at Mintek of economically viable smelting technology (BAT)



State  
Mintek  
Industry

**R1000 to 3000M**

Industry partner to develop VTM deposit for a smelting complex (2x60MW furnaces) for a detailed engineering design

**Industry, Funders, IDC, PIC, Government**







## Problem:

- Discard coal > 60 million tonnes/year, > 2 billion tonnes
- Under utilisation of high grade coal fines
- Ageing Infrastructure



## Opportunity:

- Circular economy approach
- Technology development





# How much & when can all this be achieved?



## Technology demonstration

**100M**

Technology development and  
demonstration

**3 – 5 years**

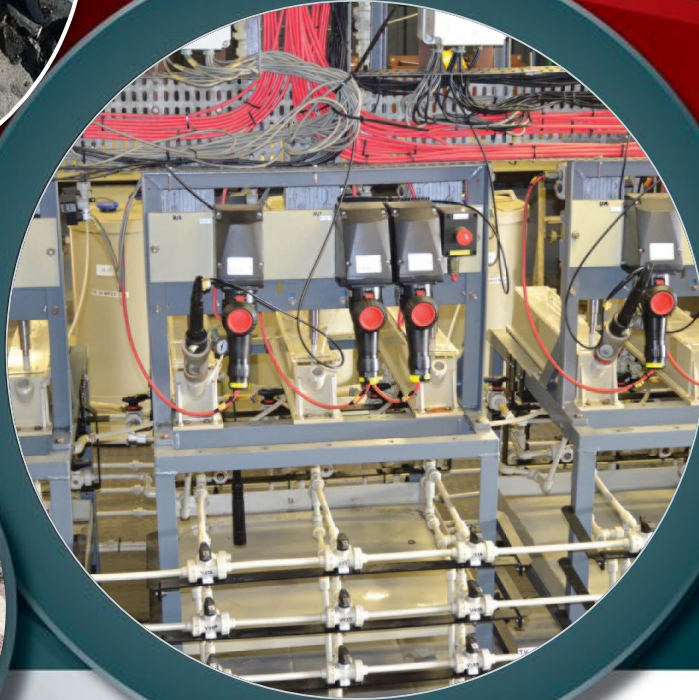
## Towards Industrialisation

**1000M**

BFS & detailed engineering design,  
Construction & commissioning

**4 – 7 years**

# Industry Development Programmes



# Transforming mine-impacted water into a resource

## Objective

Sulphate, acid and a range of metals are common contaminants of mine-impacted waters from certain sectors of the mining industry, especially coal and gold mining. **Mintek has developed a biological technology to treat the water and render it suitable for use in irrigated agriculture.**

Biological Sulphate Reduction  
(the cloSURE™ process)



## Achievements to-date:

- **Proved at pilot scale at Thungela Resources (formerly Anglo Coal)** that water can be treated and is suitable for use in the agri-industry.
- Ongoing pilot-scale programme evaluating use of liquid organic waste as substrate and inert beds to improve operability and reduce operating costs.
- **Thungela Resources has approved funding for construction of a demonstration-scale plant; detailed plant design has been completed, and construction project has commenced.**
- Mintek has secured funding from TIA for participation in design, commissioning and operation of the demonstration plant.

**Next step: Construction of demonstration plant expected to be completed in mid-year 2022**, with commissioning and multi-year operation to commence thereafter. Treated water will be applied in an agricultural programme (in partnership with the University of Pretoria).



# Establishing eWaste Processing Capacity in South Africa

## Objective

Development of an integrated process flowsheet to **recover valuable metals such as copper, tin, lead, zinc and precious metals such as silver, gold, palladium and platinum from low grade waste electrical and electronic waste (WEEE) streams.** Processing technology specifically designed for low value cathode ray tubes (CRTs) and printed circuit boards (PCBs).

## Achievements to-date:

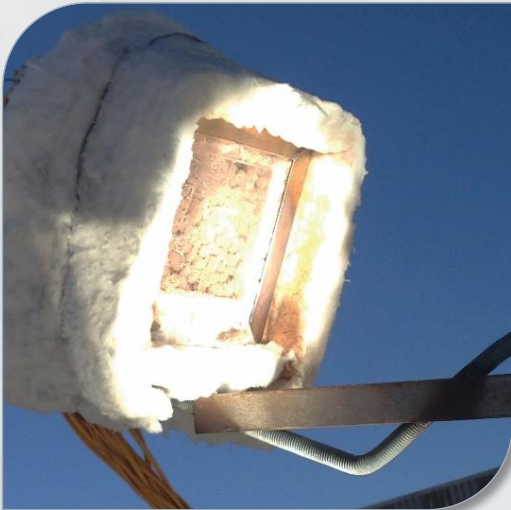
- CRTs smelting flowsheet successfully demonstrated in 4-week pilot campaign
- Discovery was made to integrate processing of CRTs with processing of PCBs by recycling of CRTs slag (as flux) to PCBs furnace, and recycling of PCBs fumes (as source of lead, zinc and tin) to CRTs furnace
- **South African provisional patent for eWasteSmelt™ process filed 16 July 2020**

## Next steps

- Undertake fundamental studies on the integrated flowsheet to advance development of the process and provide experimental evidence to support claims of the IP for filing of complete patent
- Design and install second rotary furnace to develop existing facility to demonstrate the overall **eWasteSmelt™** process flowsheet by operating CRT and PCB smelting furnaces simultaneously in the same pilot campaign, to increase confidence in the integrated technology



# Reviving the declining ferroalloys industry



## Objective

Revival of the declining ferroalloys sector by the transfer of new technology, including the introduction of renewable energy, in the production of ferroalloys.

## Achievements to-date:

- Significant technical progress made with H2020 PreMa programme, **confirmed proof of concept to reduce energy consumption by 25%.**
- Proof of concept completed for the pre-heating of ore prior to smelting.
- Solar dish acquired by Mintek to demonstrate technology.
- Process control equipment installed on a number of ferroalloy furnaces.
- **Participated in DMRE team addressing interventions to assist the sustainability of the ferroalloys sector.**

**Next step:** Installation of the Solar dish to be completed to allow demonstration of the technology developed. Continued engagement with the DMRE and sector to address sustainability issues. **Establishment of Ferro Alloys Research Association of South Africa (FARASA) with joint funding from African Rainbow Minerals and Mintek.**



# Commercial Smelting Complex for the Processing of Titaniferous Magnetite

## Objective

In addition to PGM and chrome rich layers, the Bushveld Complex contains vanadium bearing titaniferous magnetite layers, containing a vast proportion of the World's vanadium and titanium. **There is currently no demonstrated and proven economic process for the co-extraction of vanadium, titanium and iron as saleable products. Mintek is addressing this.**

### Achievements to-date:

- Multi year MTEF funded programme is in its 5<sup>th</sup> year. Main progress to date:
  - Technology assessment component completed and optimal process flowsheet determined.
  - Integrated technology facility at Mintek, including detailed engineering designs.
- **Integrated technology facility currently under construction at Mintek.**
- **Civils installation was completed and the mechanical structure is 95% complete.** Upgrade of electrical and instrumentation is in progress.



**Next step:** Completion of integrated technology facility at Mintek and thereafter demonstrate the process at a scale large enough to prove economics and attract investment (2022).

# Derelict and ownerless mine rehabilitation



## SOME NOTABLE ACHIEVEMENTS IN THE ASBESTOS REHABILITATION PROGRAMME DURING THE PAST YEAR INCLUDE:

Achieving practical completion of two (2) asbestos mine rehabilitation projects; Penge Village and Asbestos Mines in Limpopo Province.

Works at the Uitkyk, Lagerdraai and Uitval asbestos mines **rehabilitation** Lepelle Nkumpi municipality were **suspended due to ongoing community protests.**



**Top:** Erection of a gabion toe line during the construction phase

**Bottom:** The finished product showing erosion control channels and blankets in Dublin Asbestos Mine in Mafefe Village, Limpopo Province.



# Derelict and ownerless mine rehabilitation



## SOME NOTABLE ACHIEVEMENTS IN THE HOLINGS CLOSURE PROGRAMME DURING THE PAST YEAR INCLUDE:

Sealing of 41 goldmine holings in the Gauteng Province

Continuing with construction works to seal a further 14 holings.

Finalised designs for 20 a further 20 holings in the Gauteng Province.



**Top:** Unsealed GOU 14 shaft in Krugersdorp, Gauteng Province.



**Middle:** Construction in progress for the sealing of Modderfontein 14B shaft in Brakpan, Gauteng Province



**Bottom:** Marker post for the GOU 13 shaft sealed in Krugersdorp, Gauteng Province.