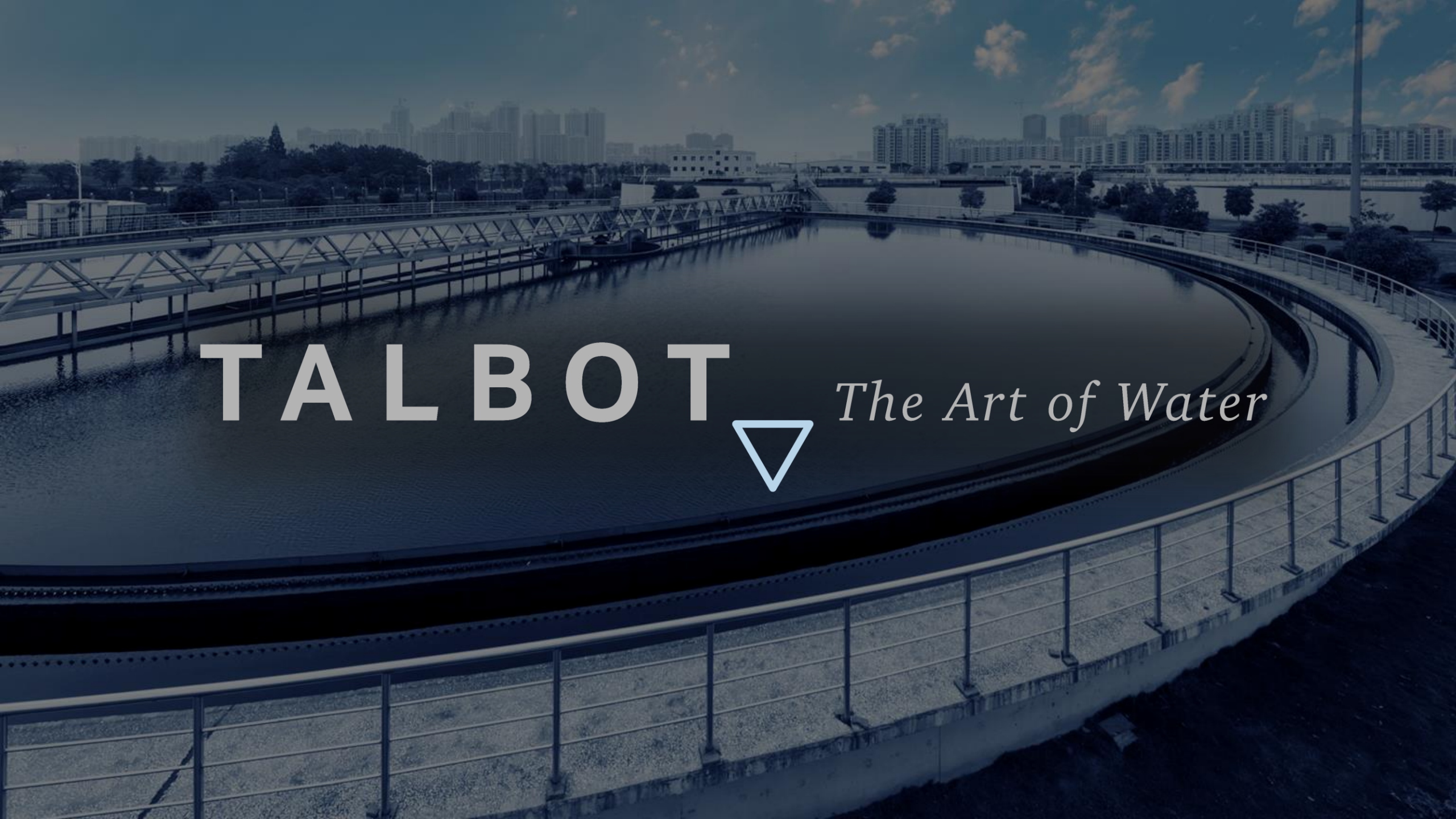
TALBOT
The Art of Water

GREEN HYDROGEN WATER NEXUS STUDY

Embassy of the Kingdom of the Netherlands

26 June 2025

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The South African Context

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THE SOUTH AFRICAN CONTEXT

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A market overview

1. Well placed to utilize vast renewable energy potential
2. Water scarce country – existing pressures on limited surface water from domestic, industrial, agricultural and environmental sectors
3. Department of Science and Innovation (DSI) developed The Hydrogen Society Roadmap (2021) – Just Energy Transition: Reducing carbon emissions by 2050
4. DSI and private businesses (Anglo, Sasol and Engie) promote GH2 Valley production for integrated circular systems within the industrial and mining sectors (GDP contribution of USD 3.9-8billion)
5. Export of GH2 to European and Asian Markets via proposed deep port in Boegoebaai
6. GH2 to be used as alternate energy source (fuel cells) in transport sector and replace use of hydrogen.

THE SOUTH AFRICAN CONTEXT

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The GH2 Water Nexus

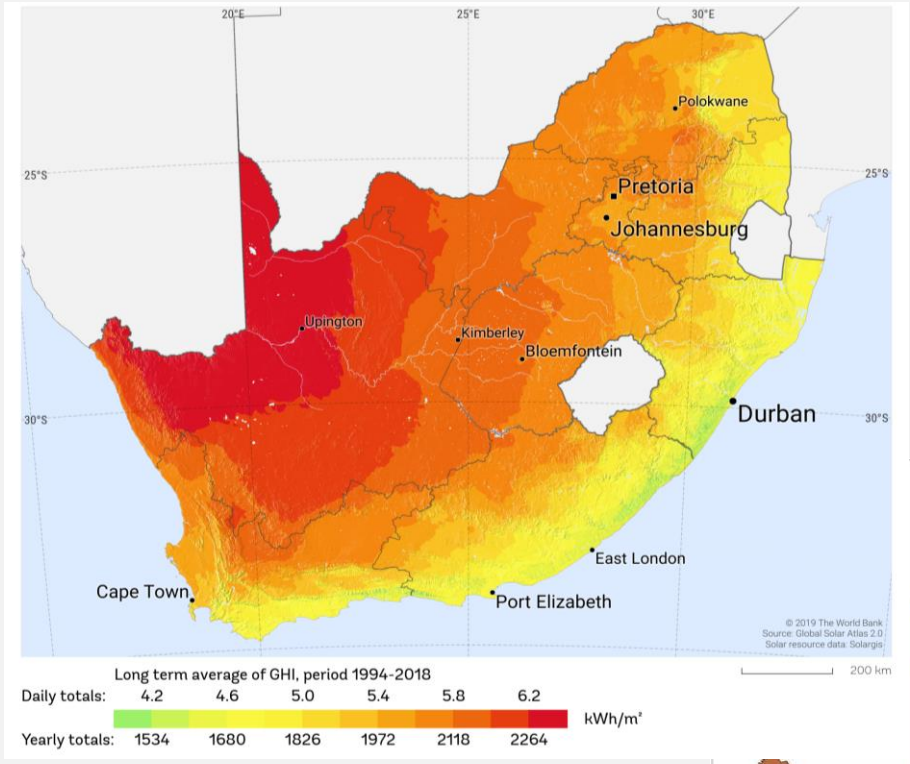
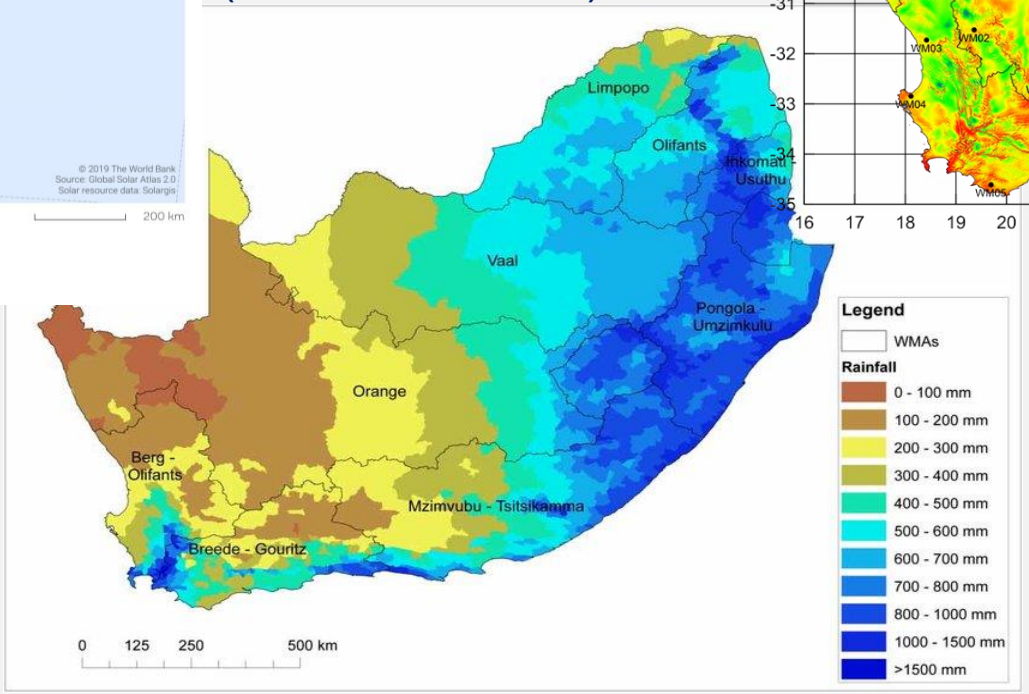


Figure 1: Annual mean solar irradiation for South Africa (Solar GIS, 2024

Figure 3: Annual mean rainfall across South Africa (Cole, M *et al*, 2017)



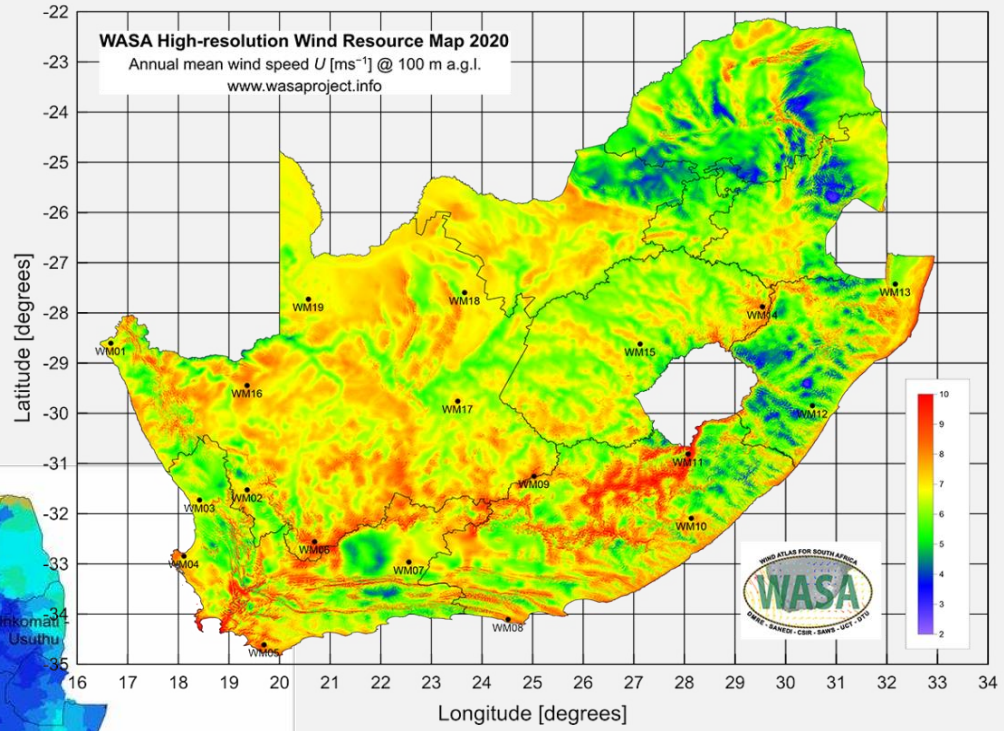


Figure 2: Annual mean wind speed for South Africa (South African Wind Atlas, 2017

THE SOUTH AFRICAN CONTEXT

Sustainable Water Supply

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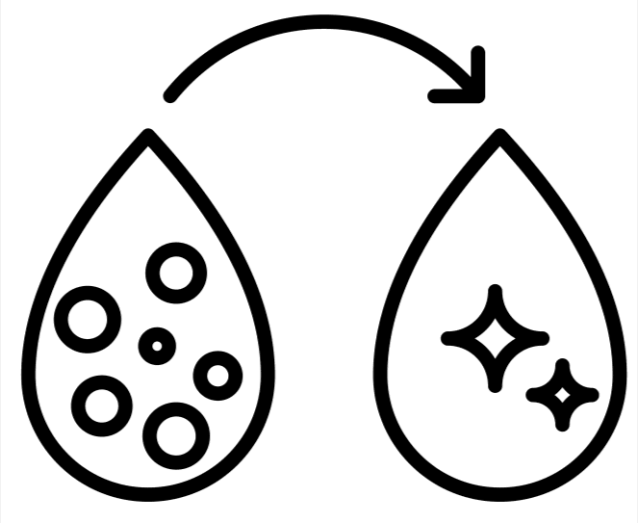
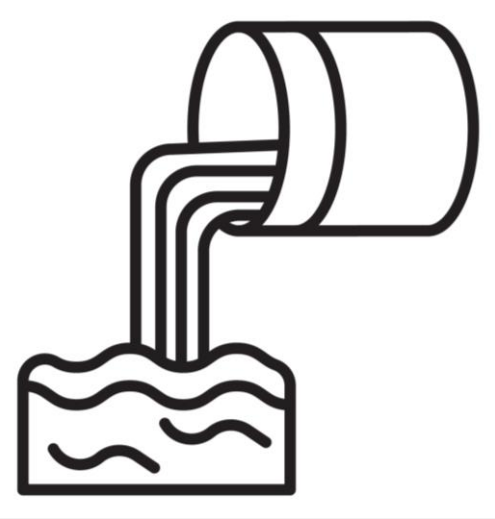
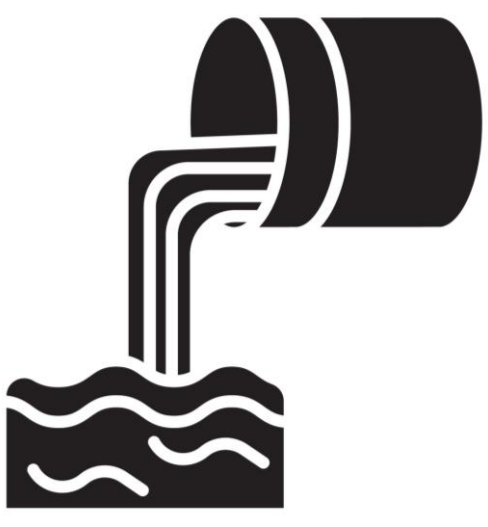


Desalination
- Seawater
- Brine waste



Wastewater
- Municipal
- Industrial



Mine Wastewater
- AMD
- Fissure water

Opportunities

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OVERALL OPPORTUNITIES

Top five opportunities identified in South Africa

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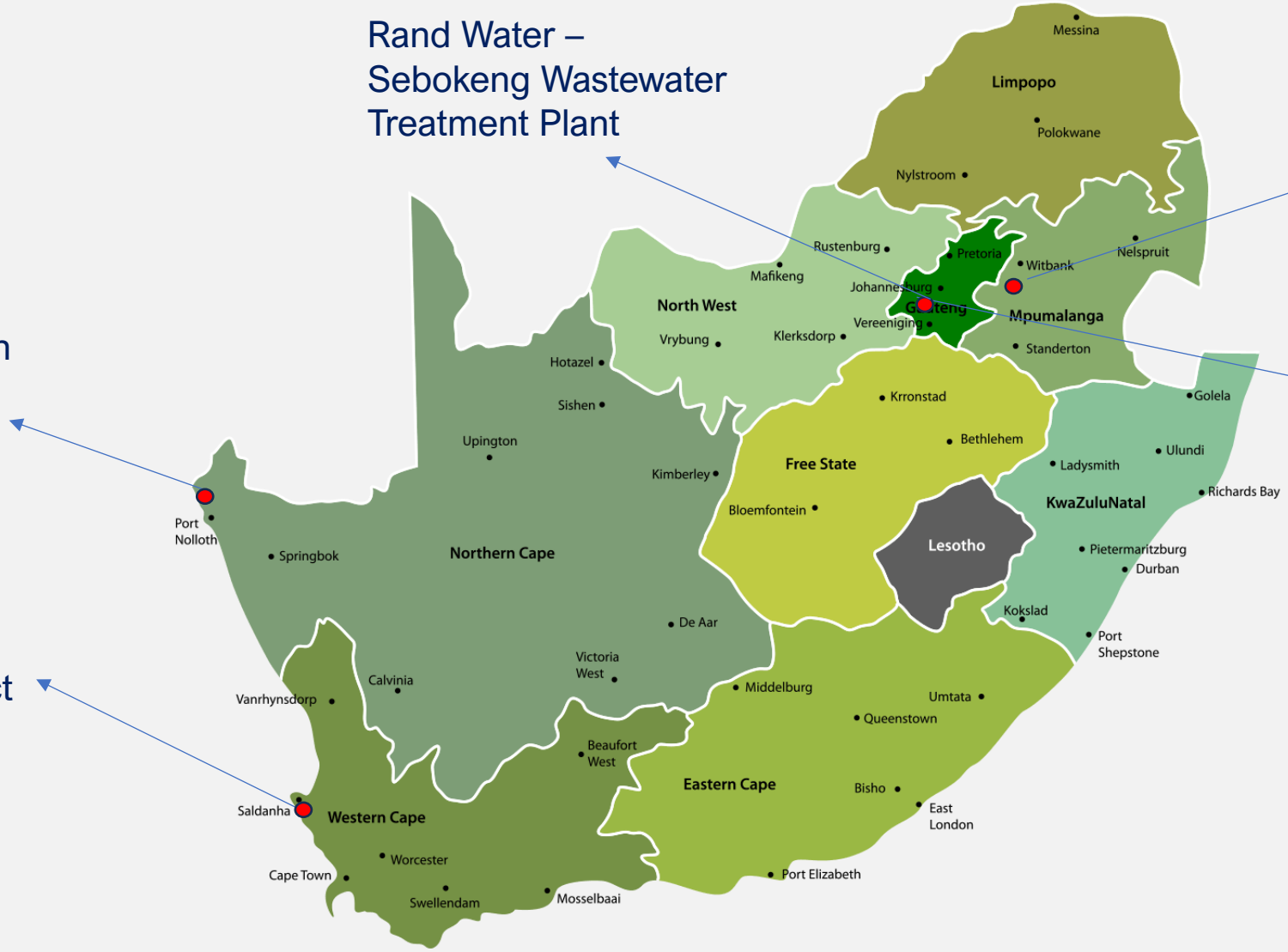
Rand Water – Sebokeng Wastewater Treatment Plant

Pan Africa Resources – Evander Mine

Boegebaai Green Hydrogen Development

Sibanye Stilwater Mine

Phelan Green Hydrogen Project



OVERALL OPPORTUNITIES

Top five opportunities identified in South Africa

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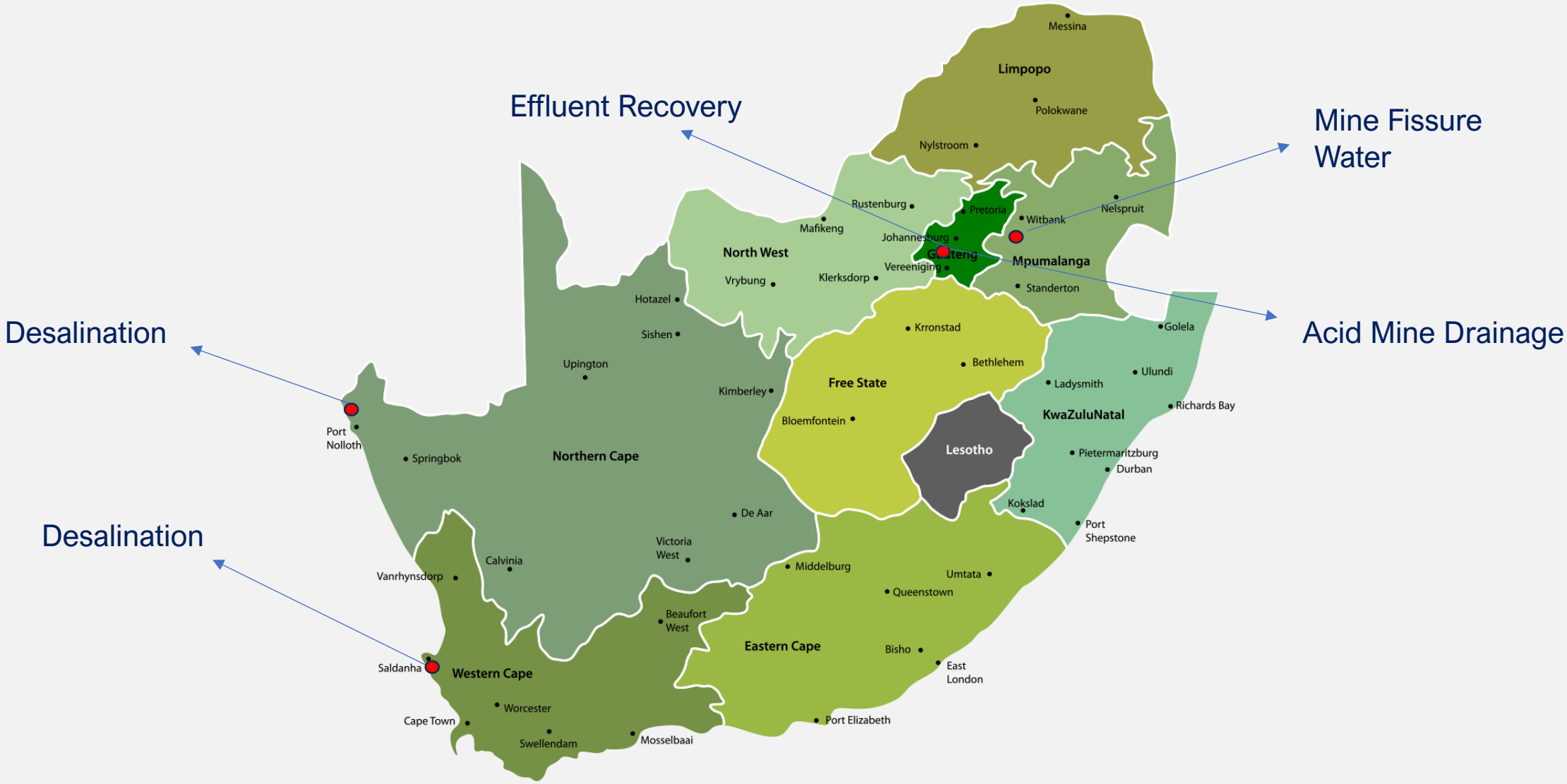

Opportunity 1

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OPPORTUNITY 1 – PAN AFRICAN RESOURCES

Mine Fissure Water

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1 **Process Water Dam**

Water Supply ~25 years, area: 5.2 Km^2

2 **Infrastructure**

Existing pipelines, transmission lines, rail and road infrastructure

3 **Benefit**

Excess treated water and GH2 produced can contribute to the surrounding area

4 **Vaal Hub**

Located in Jonhannesburg

5 **Solar Plant**

Existing solar plant with plans for increasing capacity

6 **Collaboration**

Opportunity for financial investment and technology collaboration

COST BREAKDOWN

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Green Hydrogen Production Process	CAPEX Cost (R)	OPEX Cost (R/Year)
Water Treatment	19 075 338.75	763 013.55
Renewable Energy (Solar and Wind)	R0.90/kWh	
Electrolysers	109 197 360.00	4 367 894.40
Conversion of Green Hydrogen to Ammonia	76 998 665.75	5 133 244.38
Conversion of Green Hydrogen to Liquified Hydrogen	473 200 000.00	18 928 000.00
Export of Green Hydrogen (Ammonia)	76 998 665.75	5 133 244.38

	Revenue (R)
Ammonia	35 932 710.68
Liquified Hydrogen	90 586 363.64
Export	54 351 818.18

COST ANALYSIS

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The following options were considered and a cost analysis conducted

	Option 1	Option 2	Option 3
Offtake	GH2 to ammonia	Liquified/compressed GH2	Exported GH2
Primary inputs			
Total Capex	205 271 365	601 472 699	205 271 365
Annual Operational Costs	37 141 425	50 936 181	37 141 425
Opex escalation	6.00%	6.00%	6.00%
Annual Revenue	35 932 711	90 586 364	54 351 818
Revenue escalation	6.00%	6.00%	6.00%
Returns (15-year)			
Discount rate	12.00%	12.00%	12.00%
NPV	(1 491 056 909)	(2 242 938 087)	(584 402 390)
IRR	-	(12.65%)	(3.53%)
Payback (years)	None	11	9

Opportunity 2

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OPPORTUNITY 2 – SIBANYE STILLWATER

Acid Mine Drainage

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1 **Treated Acid Mine Drainage**
30 – 40 ML per day available

2 **Infrastructure**
Existing pipelines, transmission lines, rail and road infrastructure

3 **Benefit**
Direct platinum supply for electrolyser production/collaboration

4 **Vaal Hub**
Located in Jonhannesburg

5 **Solar Plant**
Planning to include solar plant within their mines

6 **Offtake**
Domestic industrial mine use for mobility of trucks. Potential for export via SA ports

COST BREAKDOWN

TALBOT
The Art of Water

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COST ANALYSIS

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Discount rate	12.00%	12.00%	12.00%
NPV	(1 491 056 909)	(2 242 938 087)	(584 402 390)
IRR	-	(12.65%)	(3.53%)
Payback (years)	None	11	9

Opportunity 3

TALBOT

OPPORTUNITY 3 – PHELAN GREEN HYDROGEN PROJECT

Desalination

1 **Desalination**

~3.3 ML/d water supply required for electrolysis and 5-10 ML/day for cooling

2 **Infrastructure**

Existing pipelines, transmission lines, rail and road infrastructure and desalination plants

3 **Benefit**

Excess treated water and GH2 produced can contribute to the surrounding area

4 **Western Cape**

Located in Freeport Saldanha Industrial Development Zone

5 **Solar Energy**

Secured 6000ha land and 11ha land by Western Cape Government

6 **Collaboration**

Currently in advanced planning phase with production and export in 2026

COST BREAKDOWN

TALBOT
The Art of Water

Green Hydrogen Production Process	CAPEX Cost (R)	OPEX Cost (R/Year)
Water Treatment	60 693 498.75	6 993 173.55
Renewable Energy (Solar and Wind)	R0.90/kWh	
Electrolysers	109 197 360.00	4 367 894.40
Conversion of Green Hydrogen to Ammonia	76 998 665.75	5 133 244.38
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	Revenue (R)
Ammonia	35 932 710.68
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Export	54 351 818.18

COST ANALYSIS

TALBOT
The Art of Water

The following options were considered and a cost analysis conducted

	Option 1	Option 2	Option 3
Offtake	GH2 to ammonia	Liquified/compressed GH2	Exported GH2
Primary inputs			
Total Capex	**246 889 525**	**643 090 859**	**246 889 525**
Annual Operational Costs	**43 371 585**	**57 166 341**	**43 371 585**
Opex escalation	6.00%	6.00%	6.00%
Annual Revenue	**35 932 711**	**90 586 364**	**54 351 818**
Revenue escalation	6.00%	6.00%	6.00%
Returns (15-year)			
Payback (years)	**None**	**13**	**15**

Opportunity 4

TALBOT

OPPORTUNITY 4 – BOEGOEBAAI DESALINATION PLANT AND PORT DEVELOPMENT

Desalination

1 **Desalination**

16 ML/d water supply required for electrolysers and 20-40 ML/d cooling water

2 **Infrastructure**

The deep-water port has not been built yet, however, has the potential for export

3 **Benefit**

Excess treated water and GH2 produced can contribute to the surrounding area

4 **Northwest Cost**

Located in Northern Cape in SA

5 **Partnerships**

Led by Sasol, with the Northern Economic Development Agency

6 **Feasibility**

Currently in feasibility stage for a 40GW plant to produce 40 000t/year GH2

COST BREAKDOWN

TALBOT
The Art of Water

Green Hydrogen Production Process	CAPEX Cost (R)	OPEX Cost (R/Year)
Water Treatment	60 693 498.75	6 993 173.55
Renewable Energy (Solar and Wind)	R0.90/kWh	
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COST ANALYSIS

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Opex escalation	6.00%	6.00%	6.00%
Annual Revenue	**35 932 711**	**90 586 364**	**54 351 818**
Revenue escalation	6.00%	6.00%	6.00%
Returns (15-year)			
Payback (years)	**None**	**13**	**15**

Opportunity 5

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OPPORTUNITY 5 – RAND WATER

Effluent Reclamation Plant

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1 **Effluent reclamation plant**
Water Supply ~300Ml per day

2 **Infrastructure**
Reclamation plant still to be built

3 **Benefit**
Excess treated water and GH2 produced can contribute to the surrounding area

4 **Vaal Hub**
Located in Jonhannesburg

5 **Green Energy**
Land available for wind and solar production

6 **Collaboration**
Opportunity for financial investment and technology collaboration

COST BREAKDOWN

TALBOT
The Art of Water

Green Hydrogen Production Process	CAPEX Cost (R)	OPEX Cost (R/Year)
Water Treatment	17 875 338.75	715 013.55
Renewable Energy (Solar and Wind)	R0.90/kWh	
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	Revenue (R)	
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Export	54 351 818.18	

COST ANALYSIS

TALBOT
The Art of Water

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Opex escalation	6.00%	6.00%	6.00%
Annual Revenue	**35 932 711**	**90 586 364**	**54 351 818**
Revenue escalation	6.00%	6.00%	6.00%
Returns (15-year)			
Discount rate	12.00%	12.00%	12.00%
NPV	**(1 480 325 394)**	**(2 232 206 572)**	**(573 670 875)**
IRR	**-**	**(12.51%)**	**(3.24%)**
Payback (years)	**None**	**11**	**9**

Conclusions

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CONCLUSIONS

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Talbot conclude the following from the study

1	High-Level Cost Analysis	• Export of GH2 in the form of ammonia is most feasible. • Ultrapure water treatment cost is 3-4% of overall cost.
2	Safety Considerations	• Stringent safety requirements are required during storage and conversion of GH2 to ammonia.
3	CAPEX and OPEX	• The CAPEX and OPEX requirements must be addressed through partnerships between governmental bodies, private entities and international funding sources.
4	Regulations	• A supportive regulatory framework is urgently needed. Collaborations with GIZ, who have extensive investment and research experience are recommended.
5	Environmental Impacts	• Production sites require large land area and are located in high biodiversity, brine disposal adds complexity. Environmental practitioners to be involved in design phase.

Questions