WINDAC AFRICA

BREAK THE GRIDLOCK!
WIRE FOR GROWTH!

SAWEA
South African Wind Energy Association

21 - 23 OCTOBER 2025
8:00 am – 5:00 pm

CAPE TOWN, SA
CTICC 2

2025 PRESENTATION

Powering the Green Hydrogen Economy: Integrating Wind Energy and Local Innovation to Accelerate South Africa's Energy Transition

Presenter: Nolufefe Shezi

Date of Presentation: 22 October 2025

SPEAKER OVERVIEW

Nolufefe Shezi

Company: University of Johannesburg

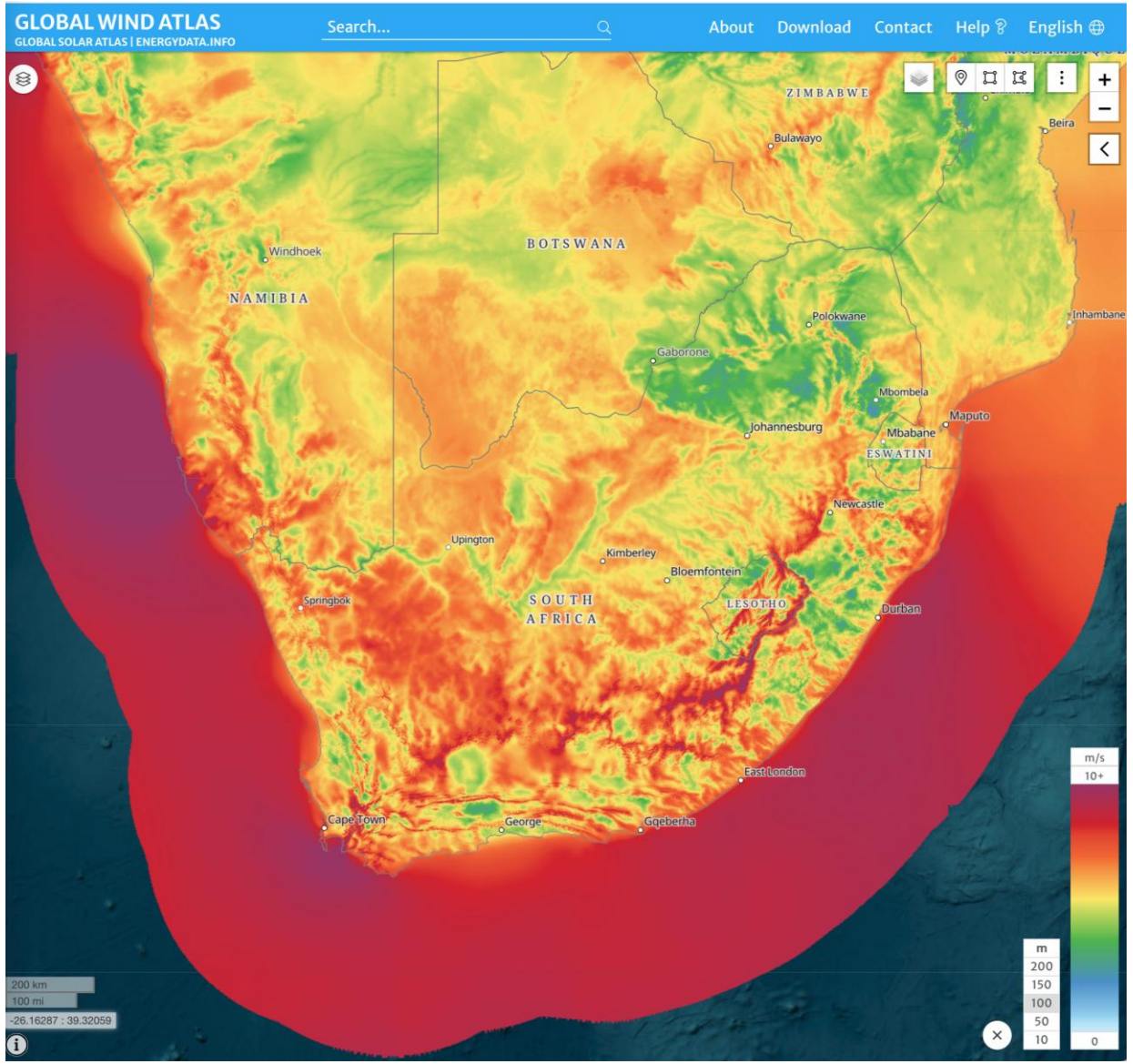
Job Title: Researcher, Department of Mechanical Engineering Science and PEETS

Research Interests: Renewable Energy Systems, Hydrogen Production, Sustainable Energy Transitions

PRESENTATION OVERVIEW

Introduction

- Growing energy demand & climate change drive renewable energy adoption.
- South Africa's wind potential (Western, Eastern & parts of the Northern Cape).
- Green hydrogen = clean, versatile energy carrier.
- Local innovation: Hydrox Holdings' DEFT™ membrane-free electrolysis for low-cost hydrogen generation.

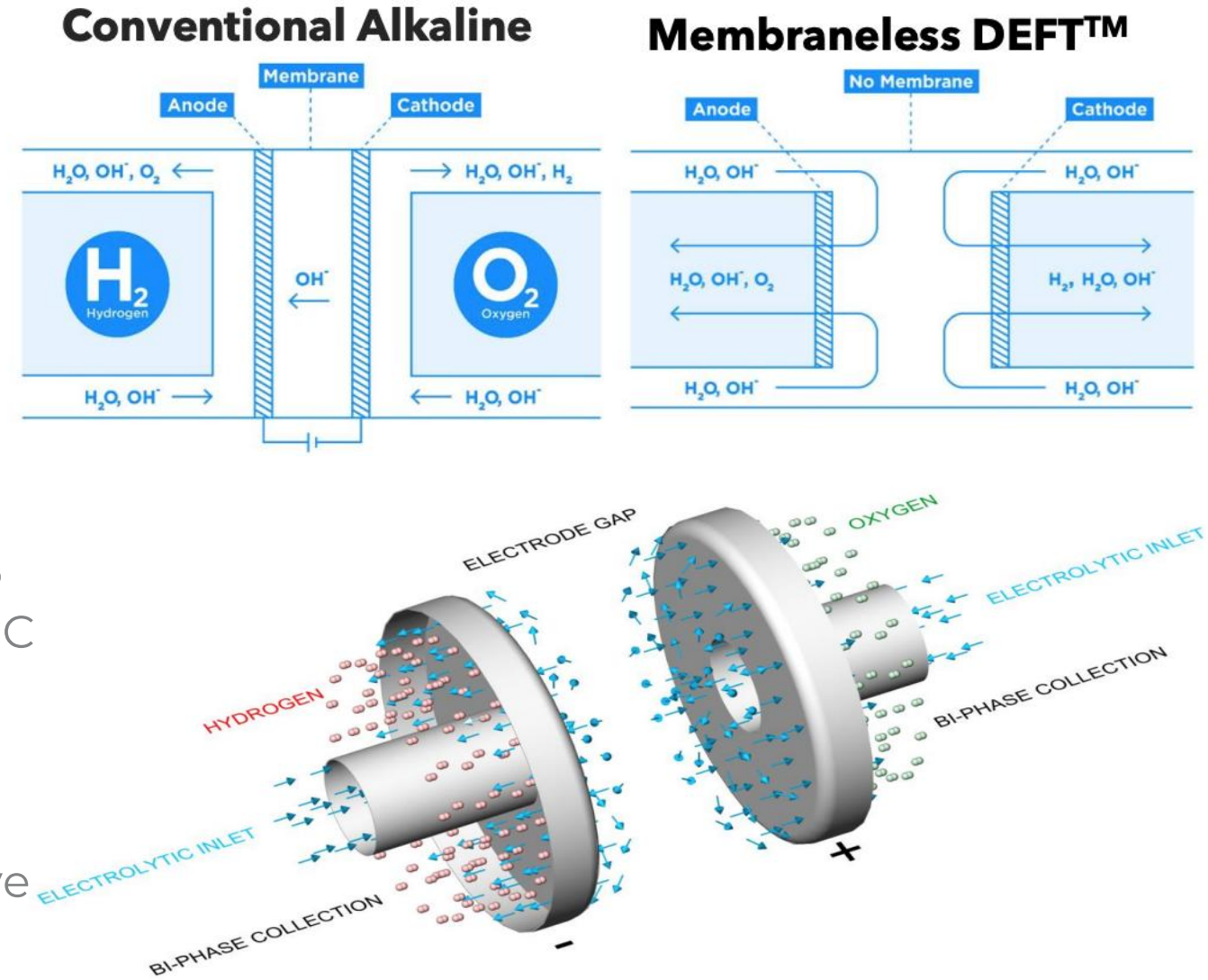


Divergent Electrode Flow Through (DEFT)™ Technology by Hydrox Holdings

Benefits:

- cost-effective
- simple design
- locally developed
- Functions at low voltages (1.8-5V)
- HHV efficiency >70% with losses at 10%
- Function at higher temperatures >80 °C
- No membrane
- 99.5 vol% Hydrogen purity

Builds technical capacity, fosters inclusive growth



Research Objective

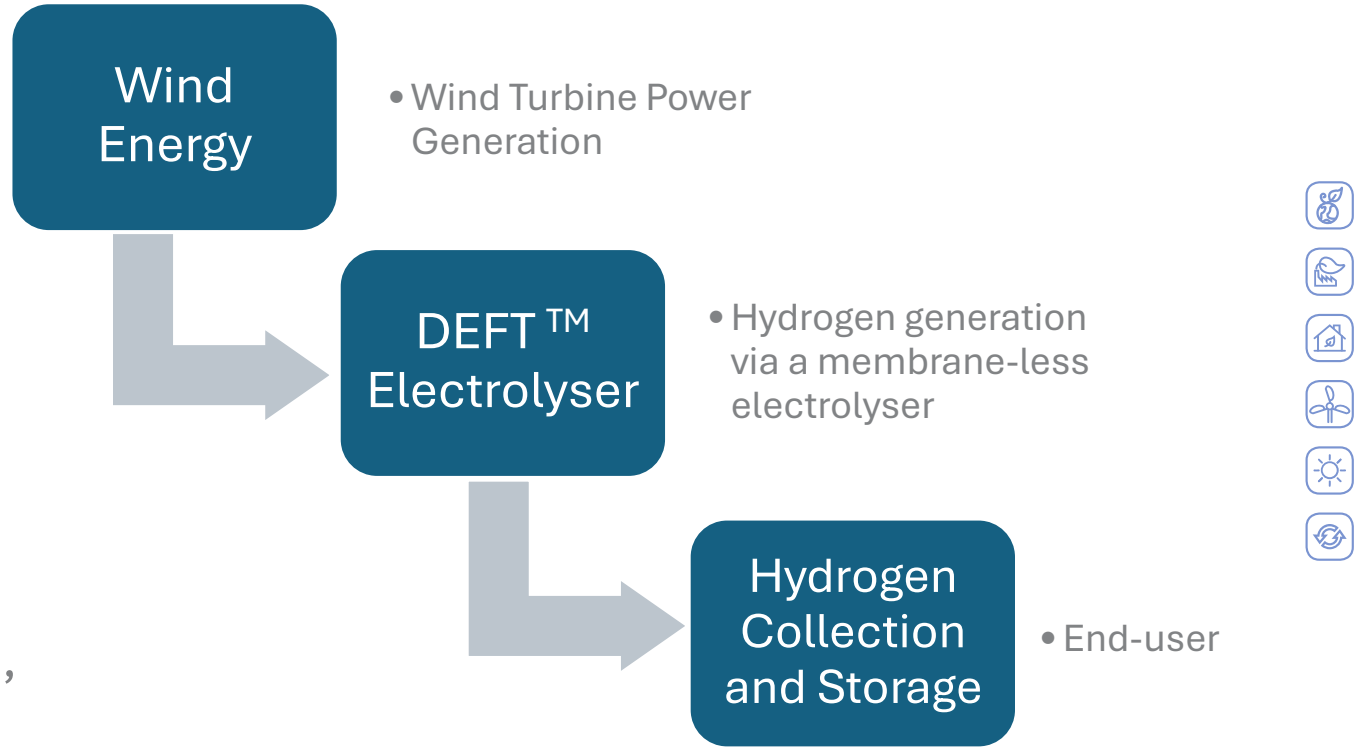
Assess how wind-powered green hydrogen using local DEFT™ technology can accelerate South Africa's low-carbon and inclusive energy transition.

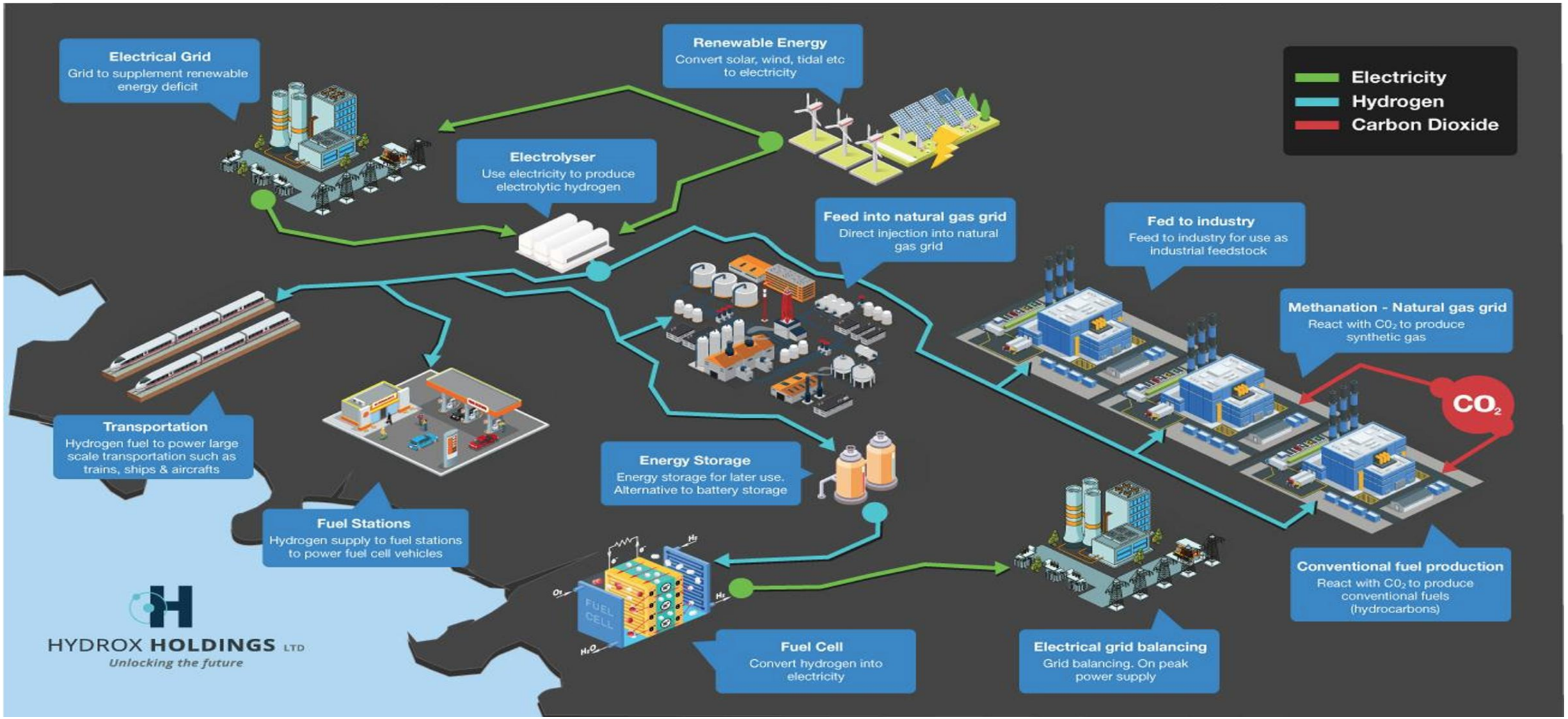

Caledon Wind Farm.

Methodology

- Multidisciplinary assessment (technical, economic, environmental, and social).

- Key Focus Areas:
  - Integration of wind energy with hydrogen electrolysis.
  - Evaluation of on-grid vs. off-grid systems.
  - Socioeconomic analysis (job creation, local industry development).
  - Policy alignment with national energy goals.




Electrical Grid
Grid to supplement renewable energy deficit
Renewable Energy
Convert solar, wind, tidal etc to electricity
Electrolyser
Use electricity to produce electrolytic hydrogen
Feed into natural gas grid
Direct injection into natural gas grid
Fed to industry
Feed to industry for use as industrial feedstock
Electricity
Hydrogen
Carbon Dioxide
Methanation - Natural gas grid
React with CO_2 to produce synthetic gas
CO_2
Transportation
Hydrogen fuel to power large scale transportation such as trains, ships & aircrafts
Energy Storage
Energy storage for later use. Alternative to battery storage
Fuel Stations
Hydrogen supply to fuel stations to power fuel cell vehicles
HYDROX HOLDINGS LTD
Unlocking the future
FUEL CELL
Fuel Cell
Convert hydrogen into electricity
Electrical grid balancing
Grid balancing. On peak power supply
Conventional fuel production
React with CO_2 to produce conventional fuels (hydrocarbons)

Findings and discussion

DEFT™ electrolyser directly integrates with wind systems (on-grid or off-grid) without additional power conditioning.

Handles fluctuating wind power efficiently with variable input voltage and current, maintaining stable hydrogen output.

Voltage Range: 1.8–2.5 V DC, achieving >70% HHV efficiency, hydrogen purity: 99.5–99.9995% (suitable for industrial and fuel-cell use), temperature operation: Over 80°C, improving efficiency and system reliability.

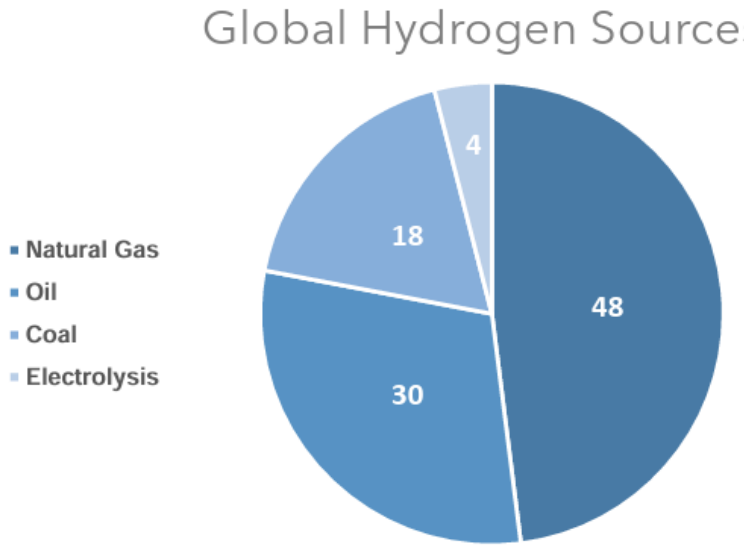
Durability: No membrane degradation or fouling, longer lifespan, and reduced maintenance.

•30 MW for 6 hours → ~3,000 kg H_2, enough for powering up to 7,000 homes (via fuel cells) or 60 hydrogen buses daily. 3,000 kg H_2 equates to ~50 MWh of usable energy (post fuel-cell conversion). Offset >100 tons of CO_2 emissions compared to fossil-derived hydrogen.

Proven at pilot and pre-commercial scale (2.5–500 Nm^3/hr systems completed with Shell Global).

Findings and discussion

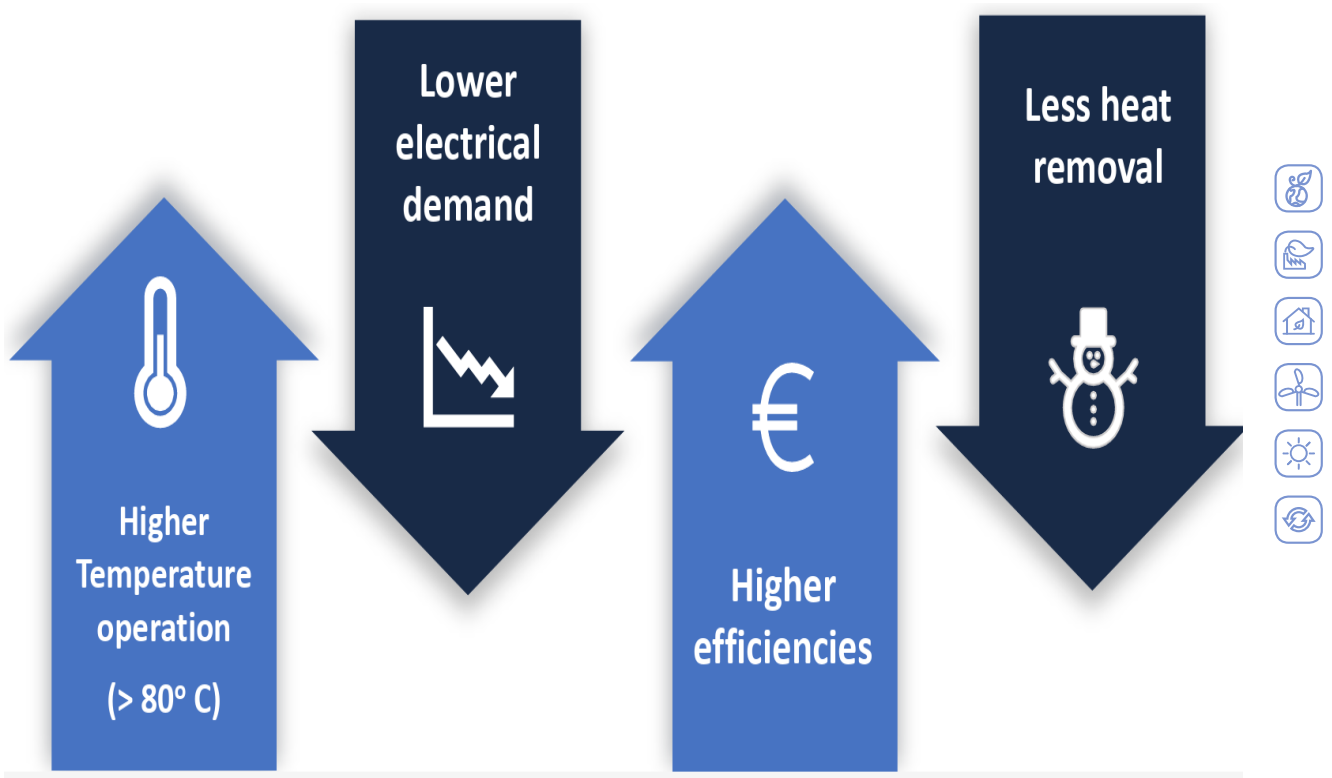
- Enables the utilization of curtailed or excess wind power converting it into green hydrogen instead of wasting generation potential.
- Stabilizes the grid by absorbing intermittent wind output improving reliability and renewable penetration.
- Provides continuous energy availability through stored hydrogen, usable when wind resources are low.
- Hydrogen Cost: Achieves production under $2.90/kg competitive with global benchmarks.



SMR and Coal Gasification	High CO_2 Grey H_2	2.6 USD/kg H_2 (SMR)
		3.4 USD/kg H_2 (Coal)
SMR and Coal Gasification – with Carbon Capture (CCS)	Low CO_2 Blue H_2	2.7 USD/kg H_2 (SMR)
		3 USD/kg H_2 (Coal)
Water Electrolysis – with renewable energy	Zero CO_2 Green H_2	5.8 USD/kg H_2 (Grid)
		2.9 USD/kg H_2 (Renewable)

Findings and discussion

- Zero Carbon Emissions: Converts renewable electricity to clean hydrogen, displacing fossil fuels in industry and transport.
- Drives OPEX reduction (no membrane replacement, lower maintenance) and extended system lifetime.
- Supports South Africa's Just Energy Transition and Green Hydrogen Strategy.
- Local innovation: Designed and manufactured in South Africa, enhancing technical skills and job creation.
- Boosts the domestic clean-tech industry and strengthens national energy security.



Conclusion

This study underscores the transformative potential of integrating wind energy with green hydrogen production in South Africa, especially by deploying innovative local solutions like Hydrox Holdings' membrane-free DEFT™ electrolysis system.

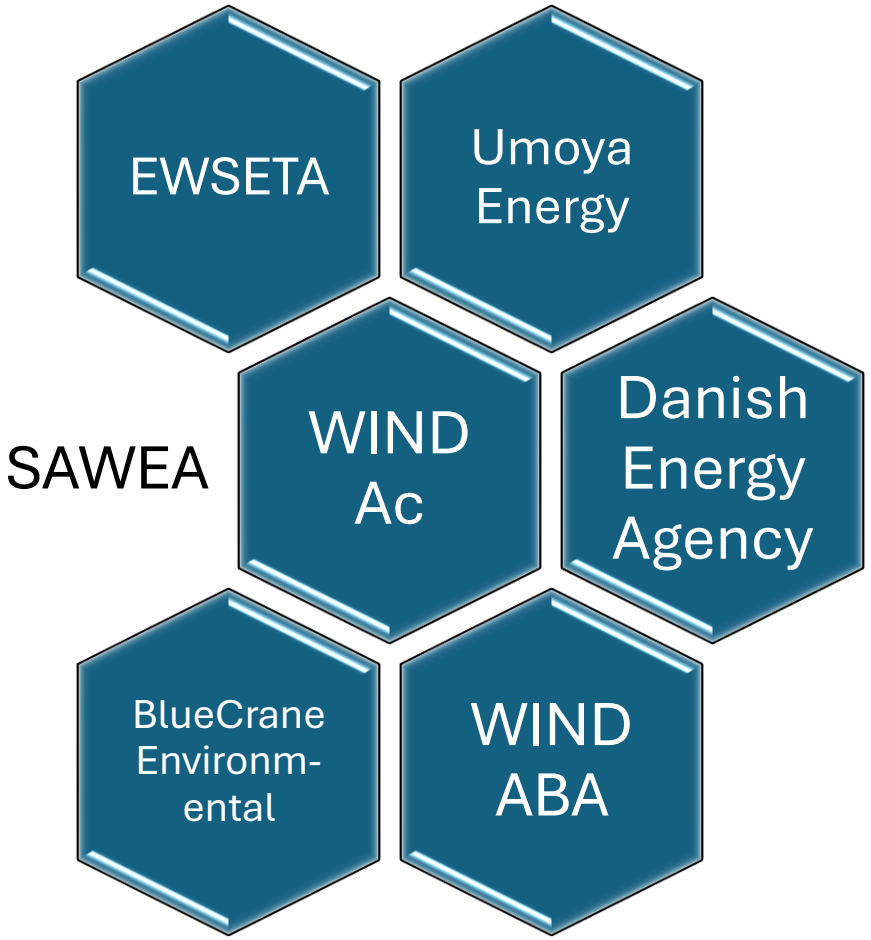
By leveraging abundant wind resources and advancing homegrown electrolysis technologies, South Africa can reduce its reliance on fossil fuels, drive economic growth, and deepen energy inclusivity.

DEFT™ technology's robust, efficient performance and flexible wind integration enable practical, cost-effective hydrogen solutions recognized globally and validated in pilot deployments.

Green hydrogen from wind offers a promising pathway to a just, low-carbon, and sustainable energy future for South Africa.

Further analysis of system performance and long-term viability will be essential, but strong initial results highlight a clear opportunity for leadership and impact.

Acknowledgements



University of Johannesburg	Hydrox Holdings	UJ PEETS
• Prof. T.C Jen • Dr. V.T Lukong	• Mr. G. Anagnostopoulos	• Dr. O.O Olatunji

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THANK YOU FOR LISTENING!

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