INFRASTRUCTURE South Africa

UNLOCKING OPPORTUNITIES FOR GREEN SHIPPING IN AFRICA

15 FEBRUARY 2023

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SETTING THE SCENE - POWERFUELS

Green H_2 production and classification [3]

RE & Electrolysis	Natural Gas & Gas Reforming + CCS	Natural Gas & SMR No CCS	Coal & Gasification No CCS

Zero to low Carbon Emissions — High Carbon Emissions

Green H_2 is made from the electrolysis of water using RE to split the water molecule into its H_2 and oxygen components. It produces no net carbon emissions in production and use

There are 2 main electrolyser technologies used to produce green H_2, alkaline water and polymer electrolyte membrane electrolysis

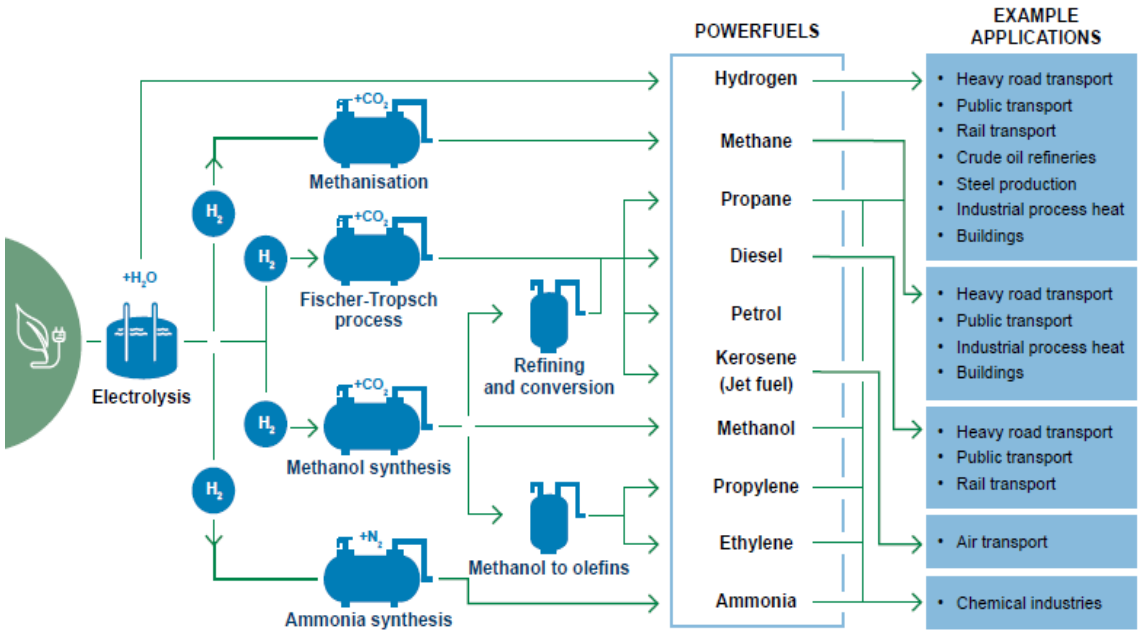
Green H_2 cost [2]

Green H_2 is currently ~ 2 - 4 times more expensive than grey H_2, but it is expected that grey and green hydrogen will reach price parity by 2030 in areas with a RE cost advantage. Grey H_2 will be more expensive than green H_2 by 2050

The cost of RE is a key driver of cost competitiveness of green H_2. **SA is well placed to provide green H_2 powerfuels, within the 2020's, below globally competitive price points**

Powerfuels production pathways [1]

Green H_2 powerfuels will be most attractive to sectors which are difficult to decarbonise
(e.g. most heavy industry, heavy duty & marine transport, fertilisers, aviation & chemicals longer term)



SETTING THE SCENE – GREEN H2 AFRICA POTENTIAL ECONOMIC IMPACT

AFRICA 2050 EXPORT POTENTIAL

20-40 MT/ ANNUM

EXPORT POTENTIAL BY PRODUCT

HYDROGEN 19MT

AMMONIA 9MT

METHENOL & SYNFUEL 13 MT

AFRICA 2050 DOMESTIC POTENTIAL

10-20 MT/ ANNUM

DOMESTIC POTENTIAL BY PRODUCT

ROAD TRANSPORT 4.8MT

INDUSTRY 4.1MT

CHEMICALS & REFINING 3.4MT

SETTING THE SCENE – SA HISTROY

H_2 research in SA spans back to 2007, through Hydrogen South Africa (HySA) led by the Department of Science and Innovation (DSI). Prior work predominantly focused on H_2-powered fuel cell electric vehicles as an alternative to internal combustion engine vehicles**. In September 2021, cabinet approved the extension of the Hydrogen Society Roadmap for the next 10 years.**

'Hard-to-abate' sectors cannot be fully decarbonised through RE and direct electrification or through RE and battery storage. **Green H_2 provides the best, long term, opportunity to decarbonise hard-to-abate sectors**, as its use is free of emissions and provides the energy density and long-term storage capabilities needed.

Broadly three (3) commercialisation lanes drive SAs green H_2 industrialisation. As per the estimates, green H_2 will initially sell at a price premium until economies of scale drive down the unit cost of RE in particular. **Across the 3 commercialisation lanes, this initial price premium is better borne by the export market than the domestic market.**

The largest single cost component for on-site production of green H_2 is the cost of the renewable electricity needed to power the electrolyser unit. This renders production of green H_2 more expensive than blue H_2, regardless of the cost of the electrolyser. A low cost of electricity is therefore a necessary condition for producing competitive green H_2. **This creates an opportunity to produce H_2 at locations around the world that have optimal renewable resources, In order to achieve competitiveness'**. [1]

Three commercialisation lanes for SA to drive industrialisation of green H_2, based on demand for powerfuels**:**

LOCAL INDUSTRY & GRID

Conversion of existing industries and grids to use green H_2 as a power source, particularly in sectors that will face drop-off in export demand if they do not decarbonise by 2030.

Contributing platinum group metals and/or actively producing H_2 fuel cells and associated technologies, linked with the conversion of maritime, aviation and heavy vehicle fleets including buses and potentially minibus taxis.

MINING & TRANSPORT

EXPORT

Producing mass scale green H_2 and derivatives for export, with flow-over into domestic consumption.

Source: 1) IRENA, 2020

SETTING THE SCENE – POTENTIAL EXPORT AND DOMESTIC DEMAND

International

- 64 countries covering 89% of global emissions have announced net zero targets
- Global H2 demand to increase by 7x by 2050 (660 MT)
- For world to limit global warming to <1.5 degrees, H2 to make up 10% – 20% of the global energy mix

Domestic

- Green H2 has the potential to remove 10 – 15% of domestic emissions
- Potential to localize productions of electrolyser and fuel cell components (65% opportunity for FDI)
- 70% of the total investment is in renewable energy and electrolyser capacity building

EXPORTS

- SA could target to export 4-8 MT of H2 and derivatives by 2050
- Strong potential to capture 4%-8% of the ammonia export market with strong possibility in Japan and South Korea
- Strong potential to export vale added products like green steel and fertilizers (have a potential to be competitive against conventional technologies with a relatively low carbon price)

SA DOMESTIC DEMAND

- SA domestic demand could reach 2-5 MT by 2050

UNDERLYING HYPOTHESIS

- Ability to attract investors to build 3-5 GW of electrolyser capacity and 6-10 GW of dedicated renewable energy by 2030
- Securing early off-take agreements
- Strong bilateral ties with Japan, South Korea, Europe, China and India
- Deep pool of technical skills and funding

SETTING THE SCENE – SA POTENTIAL ECONOMIC IMPACT

RE CAPACITY
140-300 GIGAWATTS

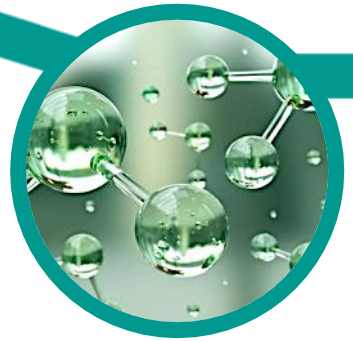
MARKET OPPORTUNITY
US$ 15-30 BN PER YEAR

CUMULATIVE INVESTMENT
US$ 100 – 250

EMPLOYMENT PROTENTIAL
1.4M JOBS

COUNTRY INVESTMENT STRATEGY

Big Frontier 1
Green Hydrogen



Big Frontier 2
Next Generation
Digital Industries and Infrastructure

Big Frontier 3
SEZ anchoring advanced manufacturing and logistics networks targeting export

Big Frontier 4
Industrial Cannabis and other advanced **agro-processing**

Big Frontier 5
Hyper-scaling **Environmental, Social and Governance (ESG)** or **Impact Investing** linked to social and green economy objectives

CATALTIC INITITAIVES

SASOL is one of the world's largest grey H_2 manufacturers (~ 2.5 mill tpa) for internal and the domestic market. Sasol can leverage its expertise and infrastructure to enter the green H_2 market. This can be done through green field facilities e.g., **Boegoebaai** and the repurpose of its current infrastructure to produce green H_2 derived products like Sustainable Aviation Fuel from the Secunda complex and repurposing electrolysers at the Sasolburg complex to produce green H_2 for the domestic market from 2023 e.g., heavy duty mobility, green steel, auxiliary power and mining.

One of the first green H_2 lighthouse projects that will be developed in SA is the Boegoebaai green H_2 SEZ, adjacent to the planned Boegoebaai port in the north west corner of the NC.

Sasol, who is leading the project, expects the Feasibility Study to take 24 months. The Boegoebaai green H_2 project has the potential to scale to a $10Bn investment bringing unprecedented economic growth and stimulating jobs in the NC Region. At full capacity, the Boegoebaai plant could drive the development of 10 GW of dedicated RE capacity and 5 GW of electrolyser capacity producing ~400 ktpa of H_2. The project is envisioned to utilise a 60/40 solar/wind supply. The Project could create up to 6 000 permanent jobs and more than 50 000 temporary jobs. Sasol will set up a consortium during feasibility to increase value and de-risk the project.

The **HYDROGEN VALLEY PROJECT** led by Anglo American Platinum will demonstrate the decarbonisation of heavy mining vehicles and heavy-duty transport from Mogalakwena in the Limpopo Province to eThekwini in the province of KwaZulu-Natal. Lessons learnt can be used to decarbonise the significant mining sector in the Northern Cape. Excess H_2 produced could enable the development of retail green H_2 infrastructure, which will be supported by the conversion of 50% of the Northern Cape's provincial fleet from ICEs to FCEVs and BEVs by 2025.

The **PRIESKA POWER RESERVE PROJECT** is led by a 100% South African, black woman-owned entity and is one of the more mature green H_2 projects as it is post, pre-feasibility stage.

This project aims to produce 70,000 tons of green ammonia per year in its first phase. Construction of the first phase will commence by 2023.

The second phase will increase the ammonia production capacity to ~ 500,000 tpa.

Thank you

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