

Proposed South African Green Hydrogen (GH₂) Commercialisation Strategy

Presentation to PCC

Summary of the Green Hydrogen Commercialisation Panel Report

Date: 29 September 2023





Background

- This Green Hydrogen Commercialisation Strategy (GHCS) builds on the strong foundation of the work undertaken by the Department of Science and Innovation (DSI) with respect to its HySA programme and the recent development and publication of the Hydrogen Society Road Map (HSRM)
- In June 2021 the Minister of Trade, Industry and Competition established the Green Hydrogen (GH₂) Commercialisation Panel (GHP) which consists of private and public sector champions in the potential GH₂ value chain and is currently being co-ordinated by the Industrial Development Corporation of South Africa (IDC)
- The objective of the Panel is to specifically focus on the development of a South African Green Hydrogen Commercialisation Strategy and Action Plan which was approved by Cabinet in November 2022 for release to the public for comments.
- Public comments closed on 31 March 2023 and the GHCS has been updated with the comments from the public for re-submission to Cabinet
- The objective of this document is to present the updated Green Hydrogen Commercialisation Strategy (GHCS) and Action Plan for South Africa



A solid historical base supports accelerated commercialisation

1

2007

Development of the **National Hydrogen and Fuel Cell Technology Strategy** by the Department of Science and Innovation and approval by Cabinet

2

2008-2018

Various demonstrator projects :
an underground fuel cell powered mining locomotive, solar-to-hydrogen system, battery and fuel cell golf cart, fuel cell generator providing lights for the UWC Nature Reserve, fuel cells for power storage for homes and cellular phone tower base stations; a Hydrogen refueling station; and fuel cell powered forklift. Green Hydrogen fuel cell system with on-site production and storage and a Hydrogen in Mining test facility, Hydrogen production, Liquid Organic Hydrogen Carriers and the use of PGM catalysts for the production of Hydrogen. HySA demonstrated a 2.5kW fuel cell system at Poelano Secondary School

3

2020

The DSI, Hydrogen SA and North West University initiate a process with the South African government to develop a **Hydrogen Society Roadmap**.

4

JUNE 2021

Presidency announces that GH₂ has been identified as the first of five “**Big Frontier**” strategic investment opportunities

5

JULY 2021

The DTIC and IDC coordinated a joint approach to sector planning by establishing a **Green Hydrogen Panel**

6

NOVEMBER 2021

At COP 26 in Glasgow, Scotland, South Africa **mobilizes funding support** for the country's decarbonization

7

FEBRUARY 2022

The HSRM is released to the public marking a momentous milestone for South Africa's hydrogen industry development

8

OCTOBER 2022

The JET-IP was approved by Cabinet and presented at COP27

9

NOVEMBER 2022

Inaugural Green Hydrogen Conference held in Cape Town

10

NOVEMBER 2022

IDC and KfW sign MOU to deploy €23m of grant funds towards catalytic green hydrogen projects

11

DECEMBER 2022

Government gazette lists 20 green hydrogen projects with 9 of them being granted SIP status

12

DECEMBER 2022

GHCS released to the public for comment (Comments closed on 31 March 2023)

Commercialisation leverages the Hydrogen Society Roadmap

Hydrogen Society Roadmap

The strategy for Commercialisation, aligns with the objectives and outcomes of, and builds on the strong foundation of the Hydrogen Society Roadmap

Objectives

- Investment
- Reduced GHG emissions
- Just Labour transition
- Balance of payment
- Energy Security
- Reduced inequality and poverty

Outcomes

- Creation of export market for SA
- Decarbonisation of transport sectors
- Decarbonisation of energy-intensive industry
- Manufacturing sector for H2 products and excellence
- Green and enhanced power sector and buildings
- *Hydrogen generation storage and distribution linked to objectives, outcomes and levers of change



science & innovation

Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA



GH₂ Commercialisation Strategy

Objectives

- Export Markets
- Domestic Markets (includes applications in hard to abate sectors and mobility)
- Local industrial capability (includes manufacturing of equipment)
- Investment and Finance
- Economic and socio-economic impact
- Affordability of a Just Transition
- Regulatory Environment

Enablers

- Skills development
- Financing
- Policy and Regulation
- Catalytic projects



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Department:
Trade, Industry and Competition
REPUBLIC OF SOUTH AFRICA

Specific actions identified in the following areas:

70

- Establish Targets and Policy Signals
- Mitigate Investment Risk
- Harmonize standards and remove barriers
- Strategic demonstration and deployment projects
- Promote RDI
- Skills development and public awareness
- Support demand creation
- **Development of a national commercialisation strategy**



Specific actions identified in the following areas:

257

- Skills and R&D
- Regulations and Policy
- Finance
- Technology Partners
- Raw Materials
- Masterplan
- Foundation for projects
- Hydrogen Hubs
- Additional project development
- Mobility projects
- Manufacturing projects
- Material handling projects
- Stationery and back up power projects
- Refueling and Distribution
- Production / Industrialisation / Manufacturing
- GH₂ Beneficiation and Export

The roadmap for commercialisation provides detail and granularity differentiating between short and long term actions by public and private sectors

The Opportunity presented by Green Hydrogen for South Africa

The GH₂ economy presents new economic, skills, employment and community opportunities for South Africa



Global Opportunity

GH₂ will play a significant role in the transition to a net-zero energy system.

It will establish SA as a future energy market global trader, securing foreign direct investment, earning foreign income and creating economic growth and development

Import Markets for GH₂ to 2050 will be the EU (2050: 11-15 Mt GHpa); Japan (2050: 5 to 10 Mt GHpa); South Korea (2050: 1.0 to 1.2 Mt GHpa) and the United Kingdom (2050: 0.5 to 0.7 Mt GHpa).



Competitiveness

South Africa's natural endowments of Land, Wind, Solar, Oceans and Green Minerals and existing Petrochemical base can be leveraged.

Together with innovations in the hydrogen sector, a robust financial system, globally recognised renewable energy programme and inclusion of GH₂ as a key element of the Government's energy transition plans

South Africa's clear differentiators are proprietary Fischer Tropsch technology and resources of platinum group metals (PGMs)



Just Transition

The Just Transition focuses on the transition of South Africa's energy sector to achieve an inclusive, low emissions and climate resilient economy

It requires that the transition is equitable to all communities and is better for our people and planet.

Transitioning away from fossil fuels will require the training and re-skilling of communities and workers reliant on fossil fuel industry and will ensure resilience and sustainability of heavy industry



Decarbonisation

- GH₂ can decarbonize much more than RE alone by replacing fossil fuel inputs in industrial processes
- GH₂ will be the global clean fuel of the future and critical to SA decarbonising our economy and ensuring the competitiveness and sustainability of our industries.
- In a global Net Zero environment, "dirty" economies will increasingly be financially penalized placing high carbon content manufactured export products at risk



Role of the commercialisation strategy

Vision

Developing a globally competitive, inclusive and low carbon economy by harnessing South Africa's entrepreneurial spirit, industrial capability, strong financial sector and natural endowments

Role of a commercialisation strategy ...

- National coordination / shared vision
- Provide policy certainty
- Encourage investors
- Guide decision makers (government, private)
- Ensure proactive industry development






... to achieve Strategic Objectives

- Secure early positioning for global export market share & competitive trade position;
- Establish domestic markets in mobility applications and hard to abate sectors;
- Secure foreign direct investment and low-cost green finance;
- Maximise Economic and Socio-Economic development benefits;
- Create an enabling policy and regulatory environment to sustain the long term growth;
- Support Local industrial capability and participation and
- Ensure a Just Transition

Market Demand Driven Commercialisation

A range of local and export use cases can anchor demand for GH₂ in South Africa

	Application Hydrogen and derived product use	Application Key Configuration				Long-term competitiveness Considered in demand scenario		Potential end-users in SA (non-exhaustive)
Industry	Ammonia production	H ₂	NH ₃	MeOH	C _x H _y	Feedstock	✓ For own demand and export	
	Methanol production	H ₂	NH ₃	MeOH	C _x H _y	Feedstock	✓ For own demand and export	
	Refineries	H ₂	NH ₃	MeOH	C _x H _y	Feedstock	✓ Potential decarb. of PetroSA	
	Steel	H ₂	NH ₃	MeOH	C _x H _y	FC/Comb.	✓ For local steel industry	
	High-Temp Process	H ₂	NH ₃	MeOH	C _x H _y	Combustion	✓ For local glass industry	
Mobility	Light Road	H ₂	NH ₃	MeOH	C _x H _y	FC	✗ BEV assumed dominant alternative	
	Heavy Road	H ₂	NH ₃	MeOH	C _x H _y	FC	✓ FCEV in commercial and public transport HDV as dominant tech	
	Off-highway	H ₂	NH ₃	MeOH	C _x H _y	FC	✓ FCEV in commercial HDV as dominant tech	
	Rail	H ₂	NH ₃	MeOH	C _x H _y	FC	? Potentially relevant (e.g., to replace diesel gen. where grid power unavailable)	
	Shipping (Ocean)	H ₂	NH ₃	MeOH	C _x H _y	FC/Comb.	✓ Ammonia for long-distance maritime shipping fuel demand	
	Aviation (International)	H ₂	NH ₃	MeOH	C _x H _y	Combustion	✓ Green kerosene to meet aviation fuel demand	
Power & Heat	H ₂ adapted turbines	H ₂	NH ₃	MeOH	C _x H _y	FC/Comb.	? As part of last mile decarbonisation of power	
	Backup power	H ₂	NH ₃	MeOH	C _x H _y	FC/Comb.	✗ Assumed negligible	
	Long/mid storage	H ₂	NH ₃	MeOH	C _x H _y	FC/Comb.	? As part of last mile decarbonisation of power	
	Grid blending (heat)	H ₂	NH ₃	MeOH	C _x H _y	Combustion	✗ Assumed negligible	

1. Indicative example of long-term (2050) cost competitiveness of presented green techs but relevant to all categories, P2G power to gas, P2L power to liquid | Source: BCG

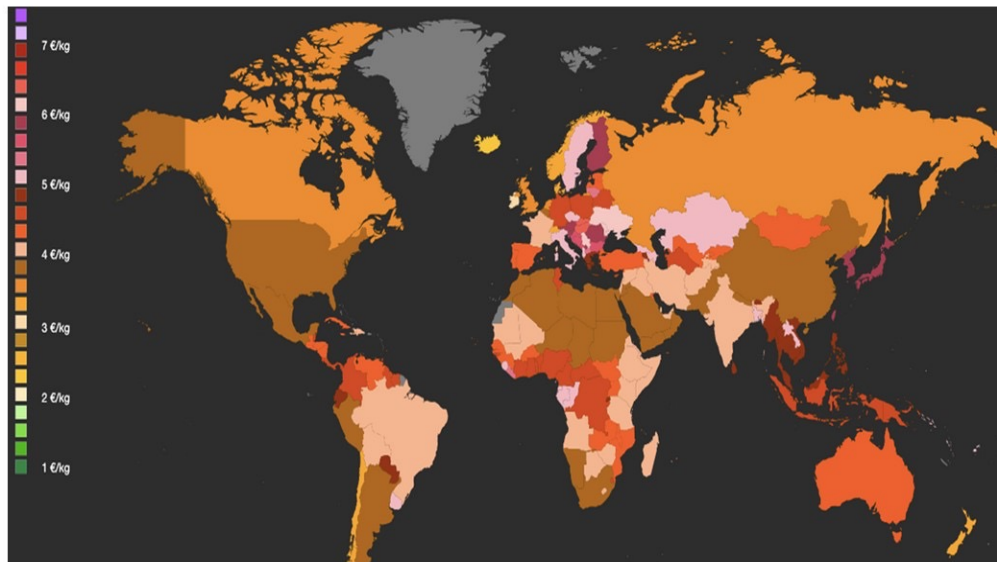
2. Efficiency improvements not included here,

South Africa's potential to be lowest cost producer

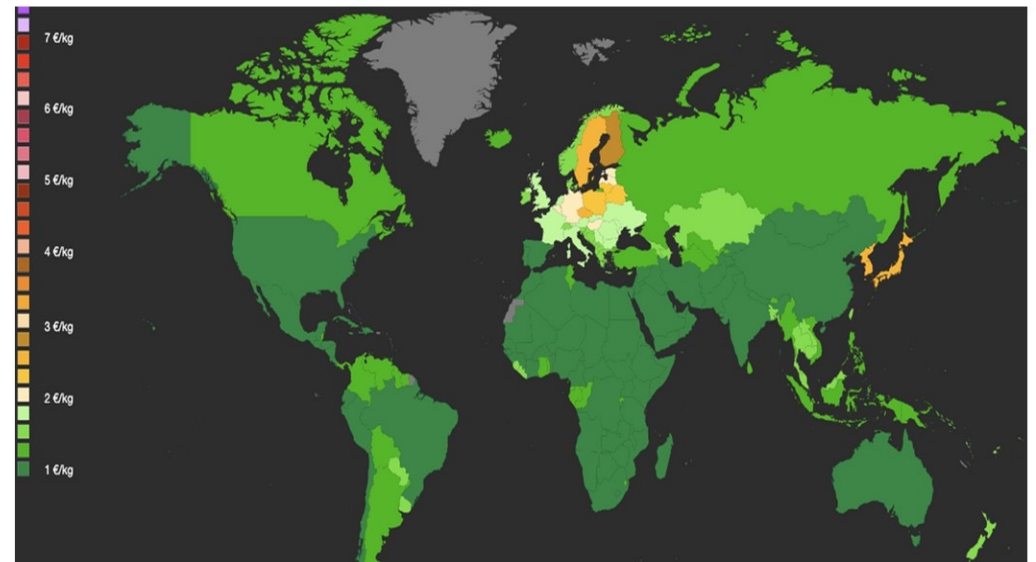
SA GH₂ could approach the \$1/kg GH₂ mark by 2050, equivalent to indigenous low cost energy, making South Africa **one of the competitive industrial economies**, however South Africa will differentiate itself by using proprietary Fisher Tropsch technology to target export of sustainable aviation fuel and will manufacture electrolyzers and fuel cells using PGMs available locally

Levelised Cost of Hydrogen (LCOH) comparable with the lowest cost producers in the world

Global Green Hydrogen Pricing - 2025*



Global Green Hydrogen Pricing - 2050*



*PwC research (2021) | based on an analysis of various renewable energy sources and electricity generation / hydrogen equipment cost reductions worldwide

- Although far from the GH₂ importing markets in Europe and Asia, South Africa has the potential to make up the cost differential through greater efficiency and government support programmes.
- In 2025, the initial focus will be on the export of GH₂ at competitive prices as domestic use will not have reached commercial parity with local fuels. As GH₂ prices decline, a broader domestic transition will unfold.



Strategic Opportunity presented by GH₂

The successful implementation of the commercialisation strategy will depend on the execution of the six key elements :

1 TARGET EXPORTS	2 STIMULATE DOMESTIC MARKET	3 SUPPORT LOCALISATION	4 SECURE FINANCING	5 PROACTIVE SOCIO ECONOMIC DEVELOPMENT
Target exports of green hydrogen and green chemicals by leveraging on South Africa's proprietary Fischer Tropsch technology and utilising financing support mechanisms including grants, concessional debt and contract for difference/price subsidies to improve the financial viability of these projects	In parallel to the export strategy, develop projects along the value chain to stimulate demand for green hydrogen in South Africa. "Low hanging fruit" opportunities to be prioritised to provide confidence in the domestic market. Examples include green steel, hydrogen valley mobility programme and sustainable aviation fuel projects.	Develop local industrial capability to produce fuel cells, electrolyser, ammonia cracking and balance of plant equipment and components by leveraging on South Africa's PGM resources. Together with demand stimulation this will drive longer term GH ₂ price reduction allowing penetration in various sectors.	"Crowd in" and secure funding from various sources and in various forms including grants, concessional debt and contract for differences.	Maximise development impact (incl. skills and economic development and social inclusion). Ensure gender equality, BBBEE and community participation. Maximise job creation and alternative options for potential job losses.

6 ROLE OF GOVERNMENT IN POLICY AND REGULATORY SUPPORT

Position GH₂ as a key early contributor to decarbonization and a just transition in the country programme of work being collated by the JET-IP Task Team ensuring a fair proportion of climate finance is sourced to enable development of this industry.

Prioritize the execution of the green hydrogen commercialisation strategy and the development of a national GH₂ infrastructure plan

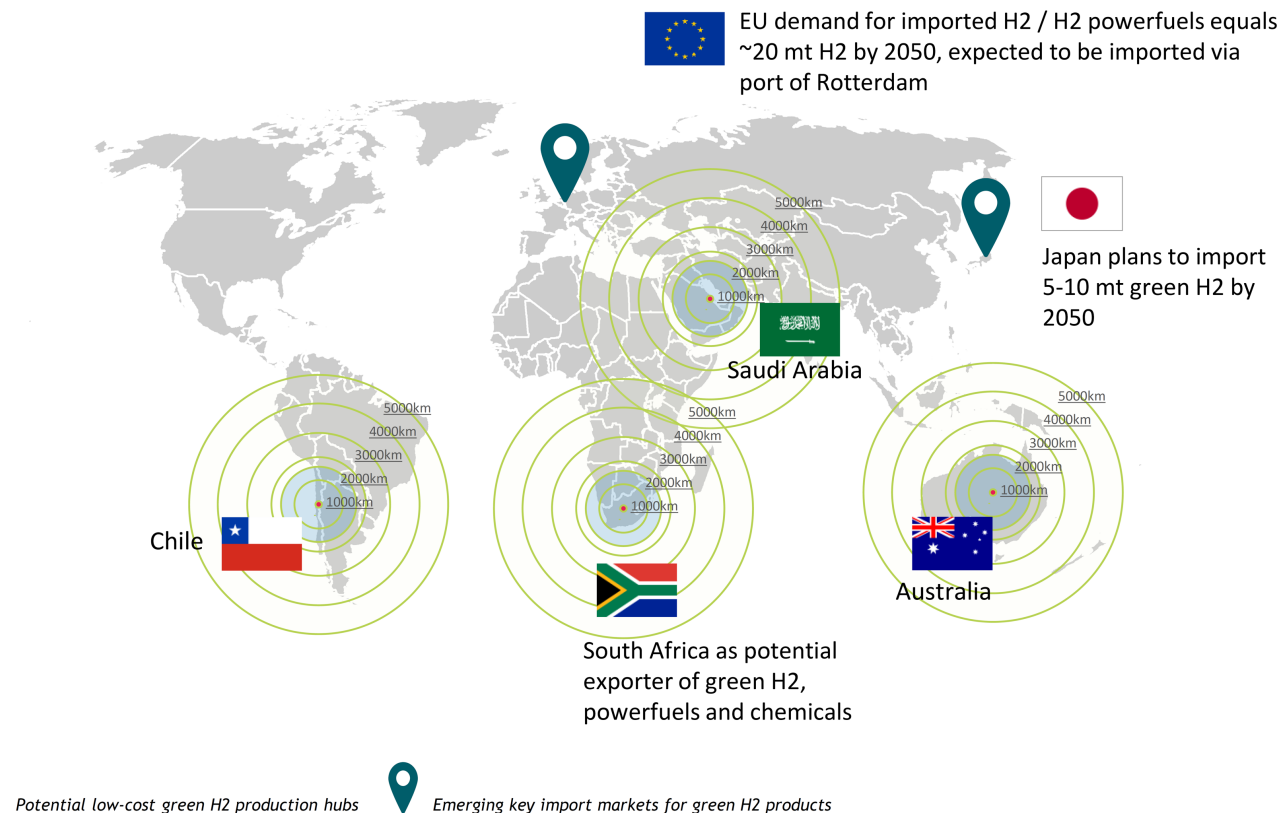
Drive the required policy and regulatory changes required to sustain long term growth of the new hydrogen industry.

Mobilise and coordinate the Government support required to support the development of this new industry for South Africa.

Strategic implementation – Targeted Export Market

Significant additional GH₂ demand could arise from supply of GH₂ products to Europe and Japan where imports of 25-30mt GH₂ is expected by 2050

- **Import Markets** for GH₂ to 2050 will be the European Union (2050: 11-15 Mt GHpa); Japan (2050: 5 to 10 Mt GHpa); South Korea (2050: 1.0 to 1.2 Mt GHpa) and the United Kingdom (2050: 0.5 to 0.7 Mt GHpa).
- **Export Potential:** South Africa is well positioned for global exports with estimates of the potential ranging between 1.9 to 8.0 Mt GHpa. Positioning on the Indian and Atlantic shipping routes could enable 8-10% market share of the global ammonia / methanol fuels market for shipping, equivalent to a further 0.8 to 1.0 Mt per year of GH₂.



Source : NBI BUSA BCG, October 2021, "The green H₂ opportunity in South Africa"

Strategic Implementation – Domestic Market Penetration

GH₂ Vision will progressively unfold penetrating multiple markets

**2023 to
2025**



Mining & Industry

Road transport, primarily Fuel Cell Vehicles (FCVs) with a focus on Heavy- Duty Vehicles (HDVs). Pilot projects already underway including hydrogen-powered trucks (Anglo Platinum's Mogalakwena mine), the Hydrogen Valley (835km industrial and commercial mobility corridor) and Sasol and Toyota South Africa Motor's partnership exploration of a mobility ecosystem.

**2025 to
2030**



Industry

Chemical and Industry, notably the non-ferrous metals, green steel, and cement sectors, which will need to decarbonize to remain globally competitive. Early opportunities in Green steel are under consideration.

**2028 to
2030**



Methanol

Green ammonia and methanol, which will replace current production from high carbon techniques. Ammonia is widely traded globally and regarded as an attractive transport vector for exporting and trading in green hydrogen.

2030



Sustainable Aviation
Fuels

Sustainable aviation fuel offers an opportunity to decarbonise air travel.

+ 2030



Balancing

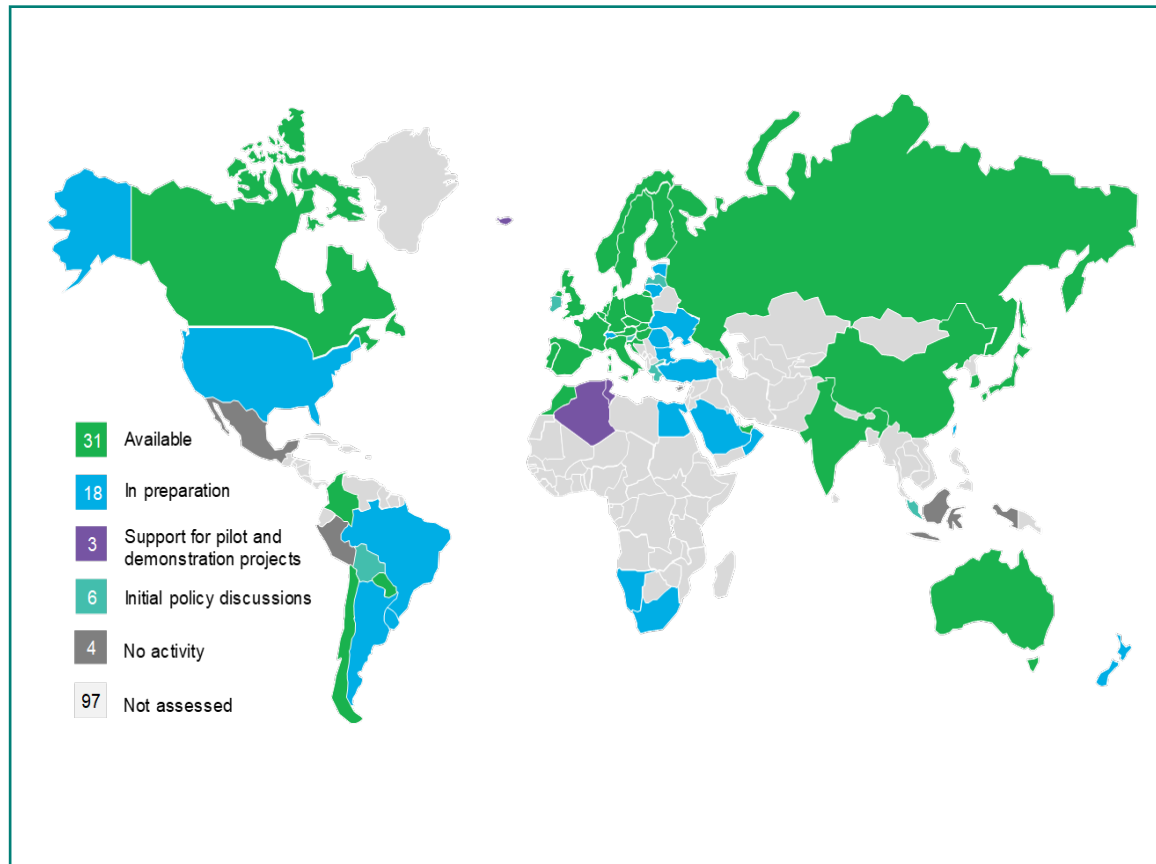
Power Storage and Balancing - Hydrogen being used for long-duration storage based on daily, monthly, and cross-seasonal balancing requirements.

Strategic Implementation - Competitive Supply: Global developments

Globally countries and private companies are developing strategies for the commercialisation of the sector.

Global hydrogen strategies

Source: Bloomberg NEF, 16 June 2022



- More than 30 countries have published a hydrogen strategy and over 200 hydrogen projects have been announced with governments committing to over \$70 billion in public funding
- Themes of strategies:
 - Early investment support to scale assets and infrastructure required to meet desired targets
 - Opportunities for sector-coupling.- optimising gas and electricity infrastructure to deliver low-cost GH₂
 - Seeding local market focus areas; including setting of national standards and priorities
 - Commercial model assessment inclusive of opportunities and the role of the state
 - Policy and detailed regulatory frameworks
 - Focus on Research and Development to improve technologies and identify initial projects
 - A social licence assessment – looking at the holistic impact of the new GH₂ market
 - International strategies on partnerships, including bi-lateral MOU's and agreements



Strategic Implementation - Competitive Supply: South Africa's competitive advantages

South Africa is well positioned to produce GH₂ thanks to three structural competitive advantages



SA with large scale, high quality RE potential and sufficient land

- ✓ Average **RE capacity factors** in South Africa are amongst the best in the world and on par with major competitors like Chile, Australia and Saudi Arabia
- ✓ SA with vast land available, just **1% of SA land area** (1.1 million ha) would be sufficient to produce **10 mt of GH₂**
- ✓ ~ 5,4 million ha in REDZ alone (areas not in competition with agriculture or settlements)
- ✓ REDZ zones alone can hold 900+ GW of RE capacity with premium capacity factors



Synergies in solving for water security

- ✓ Water required for green hydrogen **less than 0.5%** of SA water demand
- ✓ Reducing water requirement compared to coal power plants (10 mtpa of GH₂ production is only **31% of current power** sector use in coal based generation)
- ✓ Increasing water security making financially viable desalination plants at the coast (desalinated water cost is a fraction of a premium commodity like GH₂ ~\$0.01/kg)



Unique expertise for beneficiation into e-fuels and endowment of PGMs

- ✓ Proprietary **Fischer-Tropsch** technology lacking in other countries (critical for power to liquids)
- ✓ Endowment in **PGMs** required in the GH₂ value chain



Strategic Implementation : Just Transition: Inclusion & Social Impact

Significant opportunity exists for economic development and social inclusion which should be pro-actively driven through the commercialization strategy.

Hard to abate industries are sustained through GH₂

Our steel, cement, petro-chemicals and agricultural sectors currently rely on carbon-intensive heat and chemicals, which are at risk give their carbon intensity. GH₂ has the potential to accelerate the decarbonisation of these heavy industries thereby protecting local jobs

New GH₂ Industry Potential

BBBEE including community empowerment

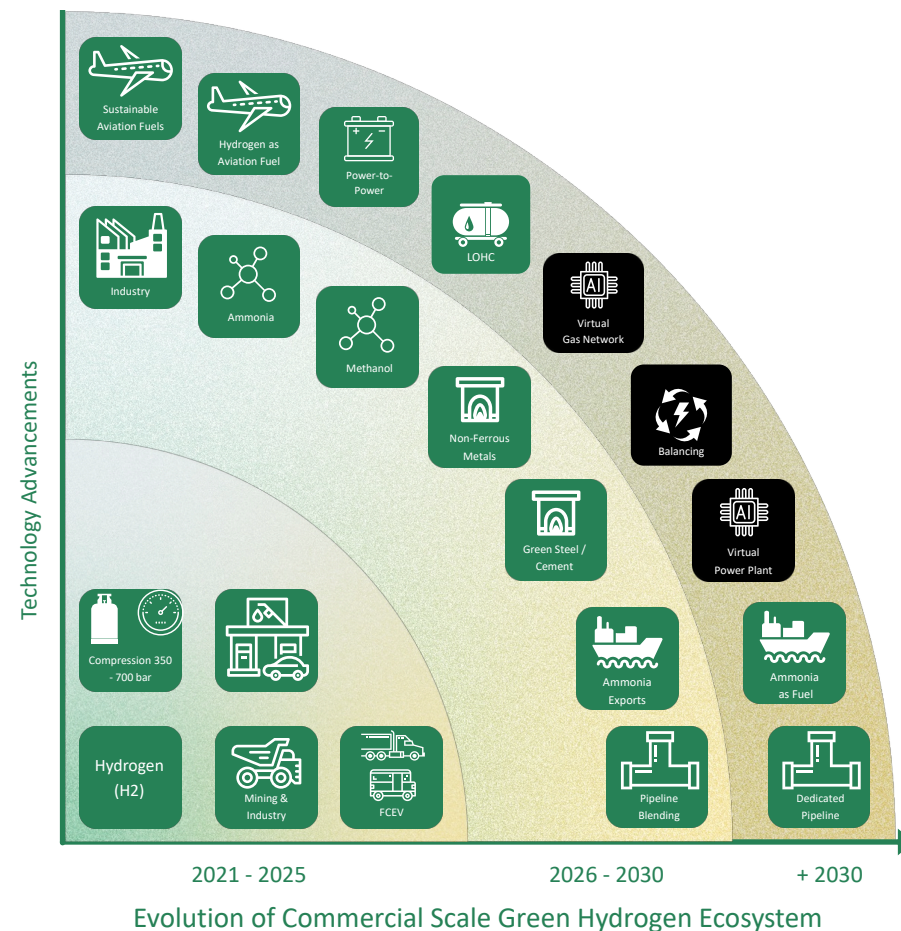
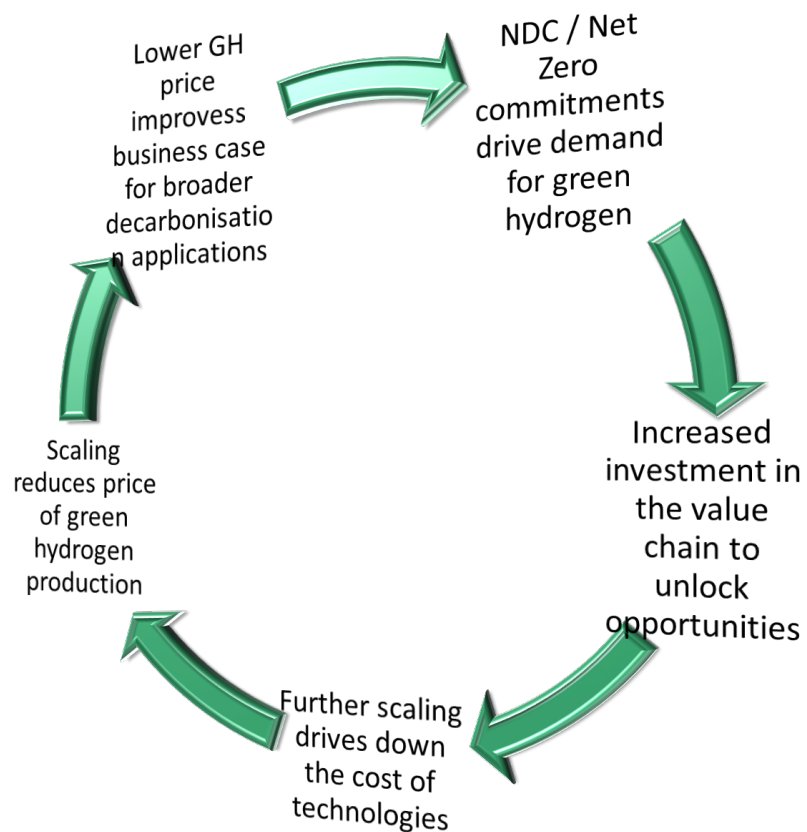
- Opportunity to empower previously disadvantaged people by taking ownership in new businesses and by providing new job opportunities.
- Communities can be empowered by shareholding in projects and by SMMEs contracting along the GH₂ value chain.

Gender equality and social inclusion

- Opportunity to integrate gender equality through empowering women to take leadership roles in green industries as entrepreneurs and / or industry professionals..

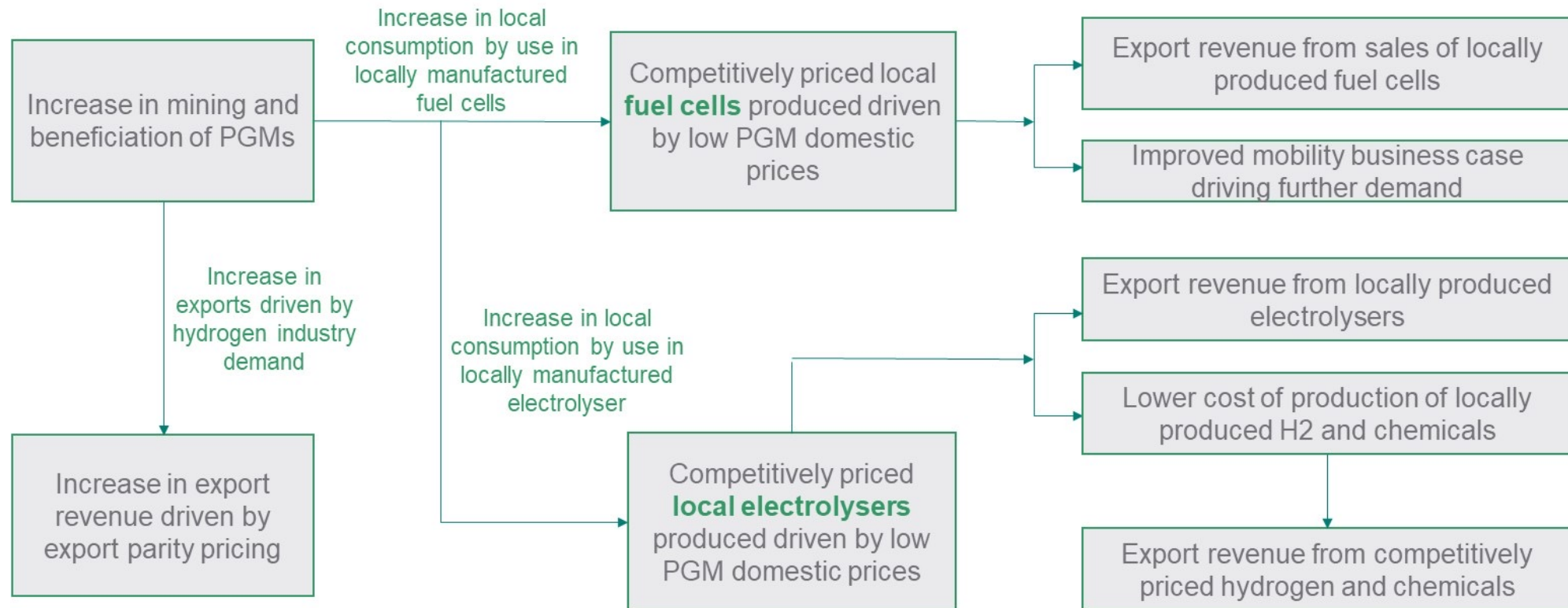
Industrialisation Opportunities : Value Chain Focus

Declining GH₂ prices will unlock opportunities across key sectors to decarbonise industry



Industrialisation Opportunities : Competitive Supply - PGMs

Increase demand for PGMs driven by the global Hydrogen Industry will enable South Africa to take advantage of both export market and local consumption





Conclusion : The path to achieve our Vision for 2050

- Hydrogen Commercialisation will build on momentum of HySA programme and the Hydrogen Society Roadmap to position South Africa as a global player in GH₂ and green chemicals
- The development of this **new GH₂ industry** will generate “needle moving” export revenue and protect critical export product in support of South Africa’s Economic Reconstruction and Recovery Plan
- Implementation of the action plans should ensure a just transition tackling gender equality and social inclusion, addressing the triple challenge of poverty, inequality and unemployment.
- Stronger partnerships will be built between Government, the private sector and civil society by creating an enabling environment
- Implementation should drive international partnerships while protecting national interest
- South African should be rebranded as a destination for sustainable investment incorporating Environmental, Social and Governance principles



**VISION 2050 – A
WELL**



ESTABLISHED



NEW

SUSTAINABLE

GREEN

HYDROGEN

INDUSTRY FOR

SOUTH AFRICA